INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

MODELS

LP-410A-FM - LP-415A-FM

This manual applies to units bearing serial no. prefixes A&B.

MP MASTER
MA28847

LAMBDA

LAMBDA ELECTRONICS MELVILLE, L. I., N. Y.

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This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics. All information contained herein applies to all LP models unless otherwise specified

LAMBDA ELECTRONICS MELVILLE, L.I., N.Y.
MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

IM-LP400

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SPECIFICATIONS AND FEATURES

Specifications apply for all models.

DC OUTPUT - Voltage regulated for line and load.

Voltage Range.....TABLE I

VOLTAGE RANGE

MODEL	LP410A-FM	LP411A-FM	LP412A-FM	LP413A-FM	LP414A-FM	LP415A-FM
VOLTAGE RANGE VDC	0-10	0-20	0-40	0-60	0-120	0-250

Multi-Current Ranges.....Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range.

TABLE II
MAX. CURRENT

MODEL	MAXIMUM CURRENT AT AMBIENT OF: 30°C	40°C	50°C	60°C
LP410A-FM	2A	1.8A	1.6A	1.4A
LP411A-FM	1.2A	1.1A	1.0A	0.8A
LP412A-FM	1.0A	0.90A	0.80A	0.60A
LP413A-FM	0.45A	0.41A	0.37A	0.33A
LP414A-FM	0.20A	0.18A	0.16A	0.12A
LP415A-FM	80MA	72MA	65MA	60MA

REGULATED VOLTAGE OUTPUT

Regulation (line)...0.01 percent plus 1.0 millivolt for input variations from 105-132 or 132-105 volts AC.

Regulation (load)...0.01 percent plus 1.0 millivolt for load variations from no load to full load or full load to no load.

Remote Programming

External Resistor.....Nominal 200 ohms/volt output

Programming Voltage.....One-to-one voltage change

Ripple and Noise....500 microvolts rms; 1.5 millivolts peak-to-peak with either positive or negative terminal grounded.

Temperature Coefficient...Output change in voltage less than (0.015% + 0.3 mv) /°C

DC OUTPUT - Current regulated for line and load; automatic crossover with voltage limit.

Multi-Current Ranges...Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range. For maximum current range see Table II. Minimum current rating: 6 ma.

Voltage Range.....For voltage range see Table I; voltage ratings apply for entire current range.

REGULATED CURRENT OUTPUT; AUTOMATIC CROSSOVER

Regulation (line).....Less than 0.2% or 5 ma. (except 7.5 ma. for LP413A and LP414A), whichever is greater, for variations from 105-132 or 132-105 volts AC.

Regulation (load).....Less than 6 milliamperes for load voltage changes from 0 to max. or max. to 0 volts DC

AC INPUT - 105-132 volts AC at 47-440 Hz. For input power see Table III. Ratings apply for 57-63 Hz; for other input frequencies consult factory.

TABLE III
INPUT POWER, WATTS*

MODEL	INPUT POWER	MODEL	INPUT POWER
LP410A-FM	75 Watts	LP413A-FM	65 Watts
LP411A-FM	65 Watts	LP414A-FM	45 Watts
LP412A-FM	85 Watts	LP415A-FM	45 Watts

*With output loaded to full 30°C rating and input voltage 132 volts AC, 60 HZ.

OVERLOAD PROTECTION

Thermal.....Thermostat, resets automatically when over-temperature condition is eliminated.

Electrical

External.....Adjustable, automatic, electronic current-limiting circuit, settable to 105 percent of rated current, limits output current to preset limit for protection of load and power supply when external overloads and direct shorts occur.

Internal.....Fuse, "SLO-BLO", 1.5A, fuse F101 protects the AC input circuit. Overload of the supply does not cause fuse failure.

Fuse F102 provides protection against internal circuit failure in conjunction with overvoltage protector option.

INPUT AND OUTPUT CONNECITONS - Heavy duty terminal block on rear of chassis with 5-foot, 3-wire detachable line cord for all models; five-way binding posts provide for additional positive (+), ground, and negative (-) DC output connections on front panel.

OVERSHOOT - No overshoot of output voltage under conditions of power turn-on, power turn-off or power failure.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE - Continuous duty from 0°C to 60°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE - (non-operating) -55°C to +85°C

METERS - Voltmeter and ammeter on all models.

CONTROLS

DC output controls.....Coarse and fine voltage controls (single ten turn control for models LP-414A-FM and LP-415A-FM) and coarse current control permit adjustment of DC output; located on front panel of all models.

Binding Posts.....Five-way binding posts on all models.
(+) (-) (GND)

Remote Sensing.....Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

Power.....Panel mounted switch and indicator light for all units.

PHYSICAL DATA

Size.....5-3/16"H x 4-3/16"W x 10"D

Weight.....7 lbs. net, 10lbs. shipping wt.

MOUNTING

Laboratory bench, table top - Bumpers secured to the base of all LP units permit proper circulation of air through the unit. Removal of bumpers will restrict free-flow of air, avioid removing bumpers. Retractable stand on bottom of unit is provided as an aid in viewing output meters. See figure 14.

Standard 19" Rack.....All LP units can be used with rack adapters:
LRA-1 (slide accomodation provided)
LRA-2 (conventional mount) See figure 15.

MODEL OPTIONS

Suffix "R" Fungus Proofing Option - Standard LP power supplies can be obtained with fungus proofing treatment with MIL V 173 varnish for all fungi nutrient components.

Suffix "V" Option.....Standard LP power supplies can be obtained for 205-265 VAC, 50Hz input or 187-242 VAC, 50Hz input. See nameplate for AC input rating. See schematic diagram for rewiring of AC input.

ACCESSORIES

Rack Adapters.....Rack adapter LRA-1, with or without chassis slides is available as well as rack adapter LRA-2 which is used for simple rack installations where chassis slides are not required.

Blank Panels.....Half-rack and quarter-rack panels can be used with the Lambda rack adapters, see figure 14.

Overvoltage Protector.Externally mounted, Overvoltage Protectors LHOV-4, LHOV-5, and LHOV-6 are available for use with LP power supplies LP410A-FM, LP411A-FM, LP412A-FM, and LP413A-FM.

THEORY OF OPERATION

GENERAL

The Lambda power supply consists of an AC input circuit and transformer; a bias supply consisting of an auxiliary rectifier and filter, and preregulator*; a main regulator circuit consisting of the main rectifier and filter, a series regulator, emitter follower driver(s), a current comparator*, a voltage comparator*, a voltage amplifier*, current and voltage sensing networks, a voltage reference* and a current amplifier*.

*This circuit element is part of integrated circuit IC101.

The circuit arrangement is shown in block diagram form, Figure 11. The circuitry is discussed with reference to the block diagram and the schematic diagram.

FUNCTIONAL DESCRIPTION

Single phase input power is applied to transformer T1 through the input circuit containing a built-in thermostat and fuse F101 which protect the supply against overheating and internal faults.

The main rectifier, a full wave rectifier, provides the power which is filtered by capacitor C109 and then regulated via a series regulator and delivered to the output. Half-wave auxiliary rectifier CR101 provides voltage filtered by capacitor C101 for the preregulator located in IC101.

Constant Voltage Circuit Operation

Constant voltage developed by IC101 across R101, R102 produces a constant current of 5 milliamperes through R108, R106, and Q103B. This current is fed through dividers R1 and, as applicable, R2 which in turn, develop a constant reference voltage for one input ot the voltage comparator. A second input, the load voltage, is compared to the reference voltage by the comparator. A change in output voltage produces an error signal at the output of the comparator. If output voltage tends to rise, the comparator conducts, less current flows through CR104 and current to driver Q101 (and/or, as applicable, Q102) is reduced. This action increases the voltage across the series regulator thus reducing the output voltage.

Constant Current Operation

Constant current developed by IC101 flows through resistor R3. A reference voltage, developed at the wiper of R3 is applied at one input to the current comparator. A second input to the comparator is the voltage developed across R107. If the current to the load tends to increase, the voltage across R107 increases causing the comparator to conduct. This action reduces current to driver Q101 (and/or as applicable, Q102) and increases the series regulator impeadance, thus limiting the output current. The current limit value is determined by the setting of resistor R3.

CONTROLS, INSTRUMENTS AND FUSES

Power ON-OFF Switch. The power ON-OFF switch, located on the front panel, controls application of input power to the supply. When the switch is in the ON position, the red power on indicator glows.

NOTE: On turn-off, power supply output voltage will become slightly negative (approximately 0.5 volts)

OUTPUT VOLTAGE Control. The OUTPUT VOLTAGE control is a dual control consisting of a coarse adjustment potentiometer, which varies the DC voltage over a range of 0-9, 0-19, 0-39, 0-59 volts, as applicable, and a fine adjustment potentiometer, which varies the DC voltage over a one-volt range*. Clockwise rotation results in increasing voltage. The total DC voltage output for voltage regulated operation is equal to the sum of each shaft setting; for current regulated operation the maximum voltage limit is equal to the sum of each shaft setting. The control is located on the front panel of all units.

*For models LP-414A-FM and LP-415A-FM the OUTPUT VOLTAGE control is a single ten turn control.

CURRENT LIMITER Control. The CURRENT LIMITER control varies the DC current over the rated current range*. Clockwise rotation results in increasing current. The control is located on the front panel of all units.

*Operation for output current below rated limits can result in no output or no regulation.

Outuut Voltage Meter. A DC voltmeter monitors the voltage at the output terminals over the rated voltage range.

Output Current Meter. A DC ammeter monitors the load output current over the rated current range.

Fuses. Fuse F101, internally located, is a 1.5 ampere, 3AG "SLO-BLO" fuse which functions in the AC input circuit.

Fuse F102, internally located, provides protection against internal circiut failure. See schematic diagrams for current ratings of pertinent F102 fuse.

Connection Terminals. Make all connections to the supply at the terminal block on the rear of the supply. DC output connections can also be made at the five-way binding posts located on the front panel. Apply input power through the line cord or directly to terminals 1 and 2 if the line cord is removed. Always connect the ungrounded (hot) power lead to terminal 1.

The supply positive terminal is borught out to terminal 6. The supply negative terminal is brought out to terminal 4. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 10. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the rear output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

GROUND CONNECTIONS

The Lambda power supply can be operated either with negative or positive output terminal grounded or with no terminal grounded. Both positive and negative ground connections are shown in the diagrams for all suggested output connections illustrated in this manual.

NOTE: When operating the supply with neither terminal grounded, high impedance leakage resistance and capacitance paths can exist between the power supply circuitry and chassis ground.

BASIC MODES OF OPERATION

This power supply is designed to operate as a constant voltage source or as a constant current source. Automatic crossover to either mode of operation occurs when load conditions change as follows:

Constant Voltage. The power supply will function as a constant voltage source while the load current does not equal the current value, I_{LIM}, set by the CURRENT LIMITER control. When load current $I_L = V/RL = I_{LIM}$ the supply will cross over automatically and will operate as a constant current source. Further decrease in value of load resistance R_L results in decrease of voltage across the load while current remains regulated to I_{LIM}.

Constant Current (Automatic Crossover). The power supply will function as a constant current source while the load voltage V_L does not equal the voltage value set by the OUTPUT VOLTAGE control. When load voltage V_L equals the value set by the OUTPUT VOLTAGE control, the supply will automatically cross over and operate as a constant voltage source.

SUPPLY-LOAD CONNECTIONS

NOTE: Refer to DETAILED OPERATING PROCEDURES for step-by-step instructions for operation of power supply.

CONNECTIONS FOR OPERATION AS A CONSTANT VOLTAGE SOURCE

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Two-Wire Connection, Figure 3. The two-wire connection, with local sensing, is the connection suitable for application with relatively constant load where extremely close load regulation over full-rated current excursion is not required at the load.

Four-Wire Connection, Figure 4. The four-wire connection with remote sensing, provides complete compensation for the DC voltage drops in the connecting cables. A 1MF, 35V capacitor may be required to reduce noise, between terminals 3,4 and 6,7, whenever remote sensing is used. +S and -S sensing leads must be twisted together.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at 200 ohms/volt output and a shorting-type switch as shown in figure 5. When continuous voltage variations are required, use variable resistor with the same 200 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply.

The output voltage of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply.

CONNECTIONS FOR OPERATION AS A CONSTANT CURRENT SOURCE

Automatic Crossover Constant Current Connections, Figure 3. Figure 3 shows the connections which are used when operating the power supply as a constant current source with automatic crossover, using local setting of current control.*

*Setting control for output currents below rated limits can result in no output or no regulation.

In this mode of operation, when the load voltage increases, due to changing load resistance, to the limit of the OUTPUT VOLTAGE control setting, the power supply crossover circuit will cause the unit to operate as a constant voltage supply.

CONNECTIONS FOR SERIES OPERATION

The voltage capability of LP power supplies can be extended by series operation of two LP power supplies of equal* voltage ratings. A maximum of 300 volts can be connected between either the +DC or -DC terminal and chassis ground, and a maximum voltage capability of 500 volts is possible for model LP-415A-FM.

*For applications using supplies of unequal ratings, consult factory for details of operation.

The two units are shown connected for series operation in figures 7 and 8. Figure 7 shows the series connection diagram which would be suitable for use in all applications where exact one-to-one voltage tracking of the "master" (M) unit by the "slave" (S) unit is not required. The slight offset in tracking is easily compensated for by adjusting the OUTPUT VOLTAGE controls on the (S) unit.

Figure 8 shows the series connection diagram suitable for applications where exact one-to-one voltage tracking is required. In this series configuration, resistor R_{BAL} permits the (S)unit to track the (M) unit on an exact one-to-one basis, thereby eliminating the possibility of an offset voltage existing between the two units.

Resistor RBAL should be a two-watt, 10 ohm/volt output, resistor. This value would permit wide-range compensation for manufacturing differences inherent in the components used in each unit. Resistors R_S and R_M function in the voltage sensing circuits of both units, enabling the (S) unit to reference its output voltage to that of the (M) unit. In figure 7, R_M performs a similar function. Capacitor C_S, used to eliminate stray AC pickup, is rated at 2.5 mfd, 100V.

For either series mode of operation, select R_S and R_M on the basis of 200 ohms per volt of (M) unit output voltage. R_S must equal R_M. Choose R_S and R_M to be low temperature coefficient resistors.

Diodes CR_M and CR_S, which protect the units against reverse voltage, must be capable of withstanding the maximum rated current of the (M) unit, and must have a reverse blocking voltage equal to 2.5 times the maximum rated output voltage.

Both methods permit operation for either constant voltage or constant current with automatic crossover to either mode of operation whenever the respective limiting operating current or voltage is reached. As shown in figures 7 and 8, each method permits connection for either local or remote sensing.

CONNECTIONS FOR PARALLEL OPERATION

The current capability of LP power supplies can be extended by parallel operation of two LP power supplies of equal* voltage capacities. The two units are shown connected for parallel operation in figures 9 and 10. One power supply designated the "master" or (M) unit controls its own output as well as the output of the second power supply, designated the "slave" or (S) unit.

*For applications using supplies of unequal voltage ratings, consult factory for details of operation.

Unit (S) operates to regulate its current to be equal to that of the (M) unit by comparing the current in its internal sampling resistor with that current sampled by the master internal sampling resistor.

Parallel connected units can be operated for constant voltage with local sensing, figure 9, or remote sensing, figure 10, as well as for constant current with automatic crossover, figure 9. When operating for constant voltage, the (M) unit can automatically cross over into constant current operation.

DETAILED OPERATING PROCEDURES

SAFETY NOTICE

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SHOCK OR INJURY.

CONSTANT VOLTAGE OPERATION, ADJUSTABLE CURRENT LIMIT

1. Apply AC power to the supply but place power ON-OFF switch in OFF position.

   NOTE: When shipped from the factory, the supply is ready for use as a constant current source with automatic cross-over or as a local-sensing constant voltage source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram. When the five way binding posts are used, do not remove barrier strip jumpers.

2. Determine load requirements, select wire size from figures 1 and 2, and choose desired type of supply-load connection from figures 3 and 4. Do not connect load.

3. Place power ON-OFF switch in ON position and check that red indicator is lit.

4. Set CURRENT LIMITER control fully CW and adjust OUTPUT VOLTAGE control knobs to obtain desired voltage indication. When the current to the load must be limited to an intermediate value within the current rating of the supply, proceed as follows: a) place power ON-OFF switch in OFF position, b) connect jumper between +V and -V terminals, c) place power ON-OFF switch in ON position and adjust CURRENT LIMITER control to obtain the desired meter indication, d) place power ON-OFF switch in OFF position and remove jumper.

5. Connect supply to load as shown on selected connection diagram.

6. Place power ON-OFF switch in ON position and check that red indicator is lit.

7. Check that output current and output voltage meters indicate desired values; as required, adjust OUTPUT VOLTAGE control knobs and CURRENT LIMITER control to obtain correct meter indications.

8. Power supply is now in proper operation.

PROGRAMMED CONSTANT VOLTAGE OPERATION, ADJUSTABLE CURRENT LIMIT

1. Apply AC power to the supply, but place power ON-OFF switch in OFF position.

   NOTE: When shipped from the factory, the supply is ready for use as a constant current source with automatic cross-over or as a local-sensing constant voltage source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram. When the five way binding posts are used, do not remove barrier strip jumpers.

2. Determine load requirements, select wire size and length from figures 1 and 2, and choose desired type of supply load connections from figures 5 or 6. Refer to paragraph on Programmed Voltage Connections.

3. Connect supply terminals as shown on the selected connection diagram. As shown in figure 5, take care to use a shorting-type switch for the external programming control when several voltages are desired and the programming voltage method is **not** used. Do **not connect load.**

4. When current to the load must be limited to an intermediate value within the current rating of the supply, proceed as follows:
   a) Connect jumper between +V and -V terminals.
   b) Place power ON-OFF switch in ON position and adjust CURRENT LIMITER control to obtain the desired current limit meter indication.
   c) Place power ON-OFF switch in OFF position and remove jumper between +V and -V terminals.

5. Connect supply to load as shown on the selected connection diagram.

6. Place power ON-OFF switch in ON position and check that red power-on indicator is lit.

7. Check that output current and output voltage meters indicate desired values; as required, adjust CURRENT LIMITER knob and external programming voltage control to obtain correct meter indications.

8. Power supply is now operating properly.

CONSTANT CURRENT OPERATION WITH CROSSOVER, ADJUSTABLE VOLTAGE LIMIT

1. Apply AC power to the supply, but place power ON-OFF switch in OFF position.

   NOTE: When shipped from the factory, the supply is ready for use as a constant current source with automatic crossover or as a local-sensing constant voltage source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram. When the five way binding posts are used, do not remove barrier strip jumpers.

2. Determine load requirements, select wire size from figures 1 and 2, and connect supply terminals as shown in figure 3. Do not connect load.

3. Adjust CURRENT LIMIT control to the desired output current as follows:
   a) Connect jumper between +V and -V terminals.
   b) Place power ON-OFF switch in ON position and adjust CURRENT LIMITER control to obtain the desired load current as indicated on current meter.

c) Place power ON-OFF switch in OFF position and remove jumper between +V and -V terminals.

4. Place power ON-OFF switch in ON position and adjust OUTPUT VOLTAGE control knobs to obtain the desired voltage limit point as indicated on voltage meter.

5. Place power ON-OFF switch in OFF position and connect load to the supply as shown in figure 3.

6. Place power ON-OFF switch in ON position and check that red power-on indicator is lit.

7. Check that output current and output voltage meters indicate desired values; adjust OUTPUT VOLTAGE control knobs and CURRENT LIMITER control as required to obtain correct indications.

8. Power supply is now in proper operation.

*SERIES CONNECTION CONSTANT VOLTAGE OPERATION, WITH CURRENT LIMIT

1. Apply AC power input to the "slave" (S) and "master" (M) units, and place power ON-OFF switches in OFF position.

   NOTE: When shipped from the factory, the supply is ready for use as a constant current source with automatic cross-over or as a local-sensing constant voltage source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram. When the five way binding posts are used, do not remove barrier strip jumpers.

2. Determine load requirements, select wire size from figures 1 and 2 choose correct type of series supply-load connections from figures 7 and 8. Refer to paragraph on CONNECTIONS FOR SERIES OPERATION.

3. Connect power supply terminals as shown on the selected connection diagram. As required, select resistors R_{BAL}, R_S, and R_M, and diodes CR_S and CR_M in accordance with instructions contained in CONNECTIONS FOR SERIES OPERATION. Do not connect load.

4. **Place power ON-OFF switches in ON position and adjust OUTPUT VOLTAGE control knobs on the (M) unit to obtain the desired meter indication. Adjust (S) unit OUTPUT VOLTAGE controls until (S) unit voltage meter indication equals (M) unit voltage meter indication. This setting will be approximately one-half of the combined (M) and (S) unit output voltage. The (S) unit will track any change in (M) unit output voltage made with the (M) unit OUTPUT VOLTAGE control. Place power ON-OFF switch in OFF position

*Applies only to units of equal voltage and current capacities, when units of unequal ratings are series connected, consult factory.

**This step does not apply to figure 8.

5. When current to the load must be limited to an intermediate value within the current rating of each supply, proceed as follows:
   a) Connect jumpers between +V and -V terminals on the (M) unit.
   b) Place power ON-OFF switch in ON possition and adjust CURRENT LIMITER control on the (M) unit to the desired current limit point, as indicated on current meter.
   c) Set CURRENT LIMITER control on (S) unit slightly above CURRENT LIMITER control setting on (M) unit.
   d) Place power ON-OFF switch in OFF position and remove jumpers between +V and -V terminals.

6. Connect supplies to load as shown on the selected connection diagram.

7. Place power ON-OFF switches in ON position and check that red power-on indicator is lit.

8. Check that output current and output voltage meters indicate desired values; adjust OUTPUT VOLTAGE control knobs and CURRENT LIMITER control as required to obtain correct indications.

9. Power supplies are now in proper operation.

SERIES CONNECTION CONSTANT CURRENT OPERATION, WITH VOLTAGE LIMIT

1. Apply AC power input to the "slave" (S) and "master" (M) units and place power ON-OFF switches in OFF position.

   NOTE: When shipped from the factory, the supply is ready for use as a constant current source with automatic cross-over or as a local-sensing constant voltage source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram. When the five way binding posts are used, do not remove barrier strip jumpers.

2. Determine load requirements, select wire size from figures 1 and 2 and choose correct type of series supply-load connections from 7A and 8A. Refer to paragraph on CONNECTIONS FOR SERIES OPERATION.

3. Connect power supply terminals as shown on the selected connection diagram. As required, select resistors R_{BAL}, R_S, and R_M and diodes CR_S and CR_M as instructed in CONNECTIONS FOR SERIES OPERATION. Do not connect load.

4. Place power ON-OFF switches in ON position.

5. Adjust (S) unit OUTPUT VOLTAGE controls until (S) unit voltage meter indication equals (M) unit voltage meter indication. The (S) unit will track any change in (M) unit output voltage made with the (M) unit OUTPUT VOLTAGE control.

6. When the voltage to the load must be limited to an intermediate value within the voltage rating of the series combination, proceed as follows:

a) Place power ON-OFF switch of the (M) unit in ON position.
b) Turn the (M) unit OUTPUT VOLTAGE control knobs until voltage meter indicates approximately one-half the total rating desired for the series combination.
c) Place power ON-OFF switch in OFF position.

7. Adjust CURRENT LIMITER control for the desired load current as follows:
   a) Connect jumpers between +V and -V terminals on (M) unit.
   b) Place power ON-OFF switch in ON position and adjust CURRENT LIMITER control to the desired load current as indicated on (M) unit current meter.
   c) Set CURRENT LIMITER control on (S) unit slightly above CURRENT LIMITER control setting on (M) unit.
   d) Place power ON-OFF switch in OFF position and remove jumpers between +V and -V terminals.

8. Connect supplies to load as shown on the selected connection diagram.

9. Place power ON-OFF switches in ON position and check that red power-on indicator is lit.

10. Check that output current and output voltage meters indicate desired values; adjust OUTPUT VOLTAGE control knobs and CURRENT LIMITER control as required to obtain correct indications.

11. Power supplies are now in proper operation.

PARALLEL CONNECTION CONSTANT VOLTAGE OPERATION, WITH CURRENT LIMIT

1. Apply AC power input to the "slave" (S) and "master" (M) units and place power ON-OFF switches in OFF position.

   NOTE: When shipped from the factory, the supply is ready for use as a constant current source with automatic crossover or as a local-sensing constant voltage source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram. When the five way binding posts are used, do not remove barrier strip jumpers.

2. Determine load requirements, select wire size from figures 1 and 2 and choose correct type of parallel supply-load connections from figures 9 and 10. Connect supply terminals as shown on the selected connection diagram, but do not connect load.

3. Place power ON-OFF switches of both (M) and (S) units in ON position.

4. Turn (M) and (S) unit CURRENT LIMITER controls fully CW.

5. Adjust (M) unit OUTPUT VOLTAGE control for the desired voltage as read on (M) unit voltage meter.

6. Place power ON-OFF switches of both units in OFF position.

7. When current to the load must be limited to an intermediate value within the current rating of each supply, proceed as follows:
   a) Connect supply to the load and place a jumper across load terminals.
   b) Place power ON-OFF switches in ON position and adjust (M) unit CURRENT LIMITER control for desired meter reading. The short circuit current will be the sum of (M) and (S) unit current meter readings.
   c) Place power ON-OFF switches in OFF position and remove jumper across load.

8. Place power ON-OFF switches in ON position and check that red power-on indicator is lit.

9. Check that output current and output voltage meters indicate desired values; adjust OUTPUT VOLTAGE control knobs and CURRENT LIMITER control as required to obtain correct indications.

10. Power supplies are now in proper operation.

PARALLEL CONNECTION CONSTANT CURRENT OPERATION, WITH VOLTAGE LIMIT

1. Apply AC power input to the "slave" (S) and "master" (M) units and place power ON-OFF switches in OFF position.

   NOTE: When shipped from the factory, the supply is ready for use as a constant current source with automatic cross-over or as a local-sensing constant voltage source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram. When the five way binding posts are used, do not remove barrier strip jumpers.

2. Determine load requirements, select wire size from figures 1 and 2, and choose correct type of parallel supply-load connections from figure 9. Connect supply terminals as shown on the selected connection diagram but do not connect load.

3. Place power ON-OFF switches of both (M) and (S) units in ON position.

4. Turn (S) unit current limiter control fully CW.

5. Adjust (M) unit OUTPUT VOLTAGE control for the desired voltage limit point as read on (M) unit voltage meter.

6. Place power ON-OFF switches of both units in OFF position.

7. Set the desired load current as follows:
   a) Connect supply to the load and place a jumper across load terminals.
   b) Place power ON-OFF switches in ON position and adjust (M) unit CURRENT LIMITER control for desired meter

reading. The regulated current will be the sum of (M) and (S) unit current meter readings.

c) Place power ON-OFF switches in OFF position and remove jumper across load.

8. Place power ON-OFF switches in ON position and check that red power-on indicator is lit.

9. Check that output current and output voltage meters indicate desired values; adjust OUTPUT VOLTAGE control knobs and CURRENT LIMITER control as required to obtain correct indications.

10. Power supplies are now in proper operation.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown

The thermostat opens the input circuit only when the temperature of the transistor heat radiator exceeds a maximum safe value. The thermostat will automatically reset when the temperature of the radiator decreases to safe operating value. After eliminating the cause(s) for overheating and allowing time for the power supply to cool to a proper temperature, resume operation of the supply. Refer to appropriate operation paragraph in DETAILED OPERATING PROCEDURES.

Fuse Shutdown

Internal component failure is prevented by fuses which protect the components from damage caused by excessive currents. Fuses will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition, and replacing the blown fuse will make the fuse protected circuit operative.

MAINTENANCE

GENERAL

This section describes trouble analysis routine, replacement procedures, calibration and test procedures that are useful for servicing the Lambda power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on specifications and features for the minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit elements, and external wiring for malfunction before trouble shooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumper and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 11, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an instrument that has a highly limited current capability. Observe proper polarity for PNP or NPN to avoid error in measurement. The forward transistor resistance is low but never zero; backward resistance is always higher than the forward resistance.

For good transistors, the forward resistance for any junction is <u>always</u> greater than zero.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional defective components could damage the replaced component.

When soldering semi-conductor devices, wherever possible, hold the lead being soldered with a pair of pliers placed between the component and the solder joint to provide an effective heat sink.

<u>NOTE</u>: The leakage resistance obtained from a simple resistance check of a capacitor is <u>not</u> always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact but not covered with solder it is a good contact. Do not attempt to cover with solder.

2. Voltage measurements can be made from either side of the board. Use a needle-point probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to the measuring instrument.

3. Wherever possible use a heat sink when soldering transistors.

4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

5. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:
   a) Select a 3/16 inch timmed copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.
   b) Dip the wick in liquid rosin flux.
   c) Place the wick onto the soldered connection and apply soldering iron onto the wick.
   d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes, and is used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:
   a) AC power of proper voltage and frequency is present at input terminals.
   b) Either positive or negative terminal is connected to chassis ground.
   c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

TROUBLE SHOOTING CHART

Symptom	Probable Cause	Remedy
1. Zero volts DC output	OUTPUT VOLTAGE controls turned fully CCW	Check OUTPUT VOLTAGE controls for proper setting and correct as necessary.
	CURRENT LIMITER control turned fully CCW	Check CURRENT LIMITER for proper setting & correct as necessary.
	Short circuit across output of supply	Check load and load connections, correct as necessary.
	F101 and/or F102 open	Replace F101 or F102; if it blows immediately, check for shorted transistors Q1, or as applicable, Q2, Q3 & capacitors C10 & C111 (and, as applicable, C14), replace as necessary.
	Series regulator section open	Check Q1, (Q2,Q3) for open, replace as necessary.
	Open CR109, CR110, (or as applicable CR111, CR112)	Check CR109, CR110 (CR111, CR112) for open replace as necessary.
	Open CR104	Check CR104 for open, replace as necessary.
	Open Q103	Check Q103 for open and replace as necessary.
	Current sensing resistor open	Check R107 for open, R3 for short; replace as necessary.
	Jumpers between terms 10-9 and 7-6 open	Check supply terminal connections; correct as necessary.
	Aux. rectifier CR101 open	Check CR101 for open; replace as necessary.
2. Unable to adjust output voltage	Damaged OUTPUT VOLTAGE controls	Check R1 and, as applicable, R2 for short or open; replace as necessary.

TROUBLE SHOOTING CHART

Sympton	Probable Cause	Remedy
2. (con't)	Jumper between terms 4-3 open	Check supply terminal connections; correct as necessary.
3. High ripple at line frequency or twice line frequency and unregulated DC output	Series regulator transistors shorted	Check Q1 (Q2,Q3) for short and replace as necessary.
	Open C109	Check C109 for open, replace as necessary.
	Defective main rectifier causes ripple at twice line frequency	Check for open in CR113 thru CR120 (as applicable).
4. Same as 3, except intermittent	Foreign matter fallen into unit	Check for loose bench hardware and wire clippings that may have fallen through cover.
5. High ripple at frequency other than line or twice line frequency	Oscillation due to defective component in filter network	Check for open C10, C102, C111 and check for open and/or short in C106 and R114. Replace defective component.
6. Large spikes at output	Capacitors C103, C104 (or as applicable C108) open	Replace C103, C104, (C108) as necessary.

ADJUSTMENT OF VOLTAGE CALIBRATION CONTROL R108

The adjustment procedure requires that the power supply is removed from associated equipment is at an ambient temperature of 25-30°C, and is operated at nominal line voltage, no load.

Whenever R1, R2, R106, R108, Q103, or IC101 are replaced, and voltage indications do not reflect maximum ratings, adjust R108 as follows:

1. Apply AC power to the supply and place power ON-OFF switch in OFF position.
2. Break seal on wiper of R108 from resistor housing.
3. Place power ON-OFF switch in ON position.
4. Turn OUTPUT VOLTAGE controls (R1and, as applicable,R2) fully CW
5. Adjust R108 until maximum output voltage is reached (as indicated on voltage meter). If better than 2% accuracy is required connect a DVM (John Fluke model 825A or equivalent) at supply output terminals to measure output voltage.
6. Place power ON-OFF switch in OFF position.
7. After adjustment is completed, remove AC power input to the supply and reseal wiper of R108 to potentiometer housing.

ADJUSTMENT OF CURRENT CALIBRATION CONTROL R102

The adjustemnt procedure requires that the power supply is removed from associated equipment is at an ambient temperature of 25-30°C and is operated at nominal line voltage, no load.

Whenever IC101, R3, R101, R102 and R107 are replaced, and current indications do not reflect maximum ratings, adjust R102 as follows:

1. Apply AC power to the supply and place power ON-OFF switch in OFF position.
2. Unsolder wiper of R102 from resistor housing and set at mid-point position.
3. Place a jumper between +V and -V terminals.
4. Turn CURRENT LIMITER control (R3) fully CW.
5. Place power ON-OFF switch in ON position.
6. Adjust R102 until output current (as read on current meter) is 110% of rating for the supply. Refer to table II for maximum current ratings.
7. Place power ON-OFF switch in OFF position.

8. After adjustment is completed, remove AC power input to the supply and solder wiper of R102 to resistor housing.

PERFORMANCE CHECKS

Checks With Constant Voltage Operation

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 12. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC DVM (John Fluke Model 871A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the load to no-load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-132 or 132-105 volts AC and check the power-supply line regulation accuracy on the differential meter.

Use a VTVM, Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

Checks With Constant Current Operation

Check the ripple or regulation of the power supply using the test connection diagram shown in figure 13. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Check the power supply load regulation accuracy while switching from the short circuit to load condition. Measure the voltage across sensing resistor Rs. Use John Fluke Model 871A or equivalent for the DVM connected across Rs. For Rs, use a resistor having the same value as resistor R107 in the unit being tested. To obtain regulation figure substitute values obtained into regulation formula:

$$\frac{\triangle E}{Rs} = \text{Regulation in milliamperes,}$$

where $\triangle E$ is the voltage change in millivolts and Rs is the resistance of the sensing resistor in ohms.

Use a Variac to vary the line voltage from 105-132 or 132-105 volts AC and check the power supply line regulation accuracy using VTVM and the regulation formula: $\triangle E/Rs$

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.
2. Lambda part number.
3. Description of part together with circuit designation.
4. If part is not an electronic part, or is not listed, provide a description, function, and location of the part.

PARTS LIST

The electrical parts located on Lambda models LP410A-FM — LP415A-FM are listed here. Parts common to a group of models are listed first. Unique parts of individual models within the group are listed separately, by model, immediately following the group common-parts listing. In addition, there are separate listings of parts for the "V" option and LHOV accessory.

COMMON PARTS
MODELS LP410A-FM — LP415A-FM

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C1 thru C9, C11	Not assigned	
C12	Cap., mylar, .033 mf, ±10%, 400 vdc	CGL-33-006
C13	Not assigned	
C101	Cap., elect., 100 mf, -10 +75%, 35 vdc	CBR-10-108
C102	Cap., mylar, .047 mf, ±10%, 200 vdc	CGL-47-018
C105	Cap., mylar, 0.1 mf, ±10%, 200 vdc	CAM-10-012
C110	Not assigned	
CR101	Rectifier	FBL-00-030
CR102, CR103, CR105	Not assigned	
CR106, CR107	Same as CR101	
CR108	Rectifier, zener diode	FBM-Z119
CR124	Rectifier, zener diode	FBM-Z139
DS1	Pilot Lamp	HRD-00-013
F101	Fuse, 1½ A, 3AG, SLO-BLO	FFC-01-500
IC101	Integrated circuit	FBT-00-034
Q4 thru Q9	Not assigned	
Q103	Transistor, dual, NPN, PNP	FBN-L182
R3	Res., var., ww, 500 ohms ±10%, 5 w	DNR-50-013
R4 thru R31	Not assigned	
R101	Res., film, 8,870 ohms ±1%, ¼ w	DCS-89-073
R102	Res., var., ww, 10,000 ohms ±10%, 1½ w	DNT-10-009
R106	Res., ww, 1,200 ohms ±3%, 2 w	DFS-12-030
R108	Res., var., ww, 1,200 ohms ±20%, 1 w	DRS-12-015
R109	Res., comp., 36,000 ohms ±5%, ½ w	DEB-3635
R110, R111	Not assigned	
R112	Res., comp., 22,000 ohms ±10%, ½ w	DEB-2231
R113	Res., comp., 100 ohms ±10%, ½ w	DEB-1011
R118	Not assigned	
R119	Res., comp., 4,700 ohms ±10%, ¼ w	DCB-4721

COMMON PARTS (Cont.)
MODELS LP410A-FM — LP415A-FM

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R120	Res., comp., 6,800 ohms ±5%, ¼ w	DCB-6825
R123	Res., comp., 1,000 ohms ±10%, ¼ w	DCB-1021
R124	Res., comp., 22 megohms ±10%, ¼ w	DCB-2261
S1	Switch	FDA-11-040
XF101, XF102	Fuse clips (4 req'd)	HRM-00-005

UNIQUE PARTS
MODEL LP410A-FM

C10	Cap., elect., 400 mf, -10 +100%, 30 vdc	CBR-40-034
C103, C104	Cap., mylar, 0.018 mf, ±10%, 200 vdc	CGL-18-005
C106	Cap., mylar, 0.0022 mf, ±10%, 200 vdc	CGK-22-008
C107	Cap., elect., 3.0 mf, -10 +75%, 100 vdc	CBN-30-015
C108	Not assigned	
C109	Cap., elect., 1,500 mf, -10 +100%, 30 vdc	CBS-15-055
C111	Cap., mylar, 0.1 mf, ±10%, 200 vdc	CAM-10-012
CR104	Rectifier	FBL-00-030
CR109, CR110	Not assigned	
CR111	Rectifier	FBL-00-047
CR112	Not assigned	
CR117, CR118	Same as CR111	
CR119 thru CR123	Not assigned	
F102	Fuse, 5A, 3AG, NORM-BLO	FFB-05-000
M1	Voltmeter, 0-10 V	EBP-10-040
M2	Ammeter, 0-2 A	EDN-20-036
Q1	Transistor, NPN	FBN-36485
Q2, Q3	Not assigned	
Q101, Q102	Transistor, NPN	FBN-L109
R1, R2	Res., dual, var., ww, 1,800 ohms/ 200 ohms ±5%, 2 w (1 req'd)	DNS-20-060
R103	Res., comp., 4,700 ohms ±10%, ½ w	DEB-4721

UNIQUE PARTS (Cont.)
MODEL LP410A-FM (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R104	Res., ww, 650 ohms ±5%, 3 w	DFR-65-062
R105	Not assigned	
R107	Res., ww, 0.166 ohm ±5%, 5 w	DFM-17-071
R114	Res., comp., 330 ohms ±10%, ¼ w	DCB-3311
R115	Res., comp., 3,300 ohms ±10%, ½ w	DEB-3321
R116, R117	Not assigned	
R121	Res., comp., 47,000 ohms ±10%, ¼ w	DCB-4731
R122	Not assigned	
T1	Transformer	ABA-410B

MODEL LP411A-FM

C10	Cap., elect., 400 mf, -10 +100%, 30 vdc	CBR-40-034
C103, C104	Cap., mylar, 0.018 mf, ±10%, 200 vdc	CGL-18-005
C106	Cap., mylar, 0.0022 mf, ±10%, 200 vdc	CGK-22-008
C107	Cap., elect., 3.0 mf, -10 +75%, 100 vdc	CBN-30-015
C108	Not assigned	
C109	Cap., elect., 1,000 mf, -10 +100%, 40 vdc	CBS-10-054
C111	Cap., mylar, 0.1 mf, ±10%, 200 vdc	CAM-10-012
CR104	Rectifier	FBL-00-030
CR109, CR110	Not assigned	
CR111, CR112	Rectifier	FBL-00-047
CR113 thru CR116	Not assigned	
CR117, CR118	Same as CR111	
CR119 thru CR123	Not assigned	
F102	Fuse, 3A, 3AG, NORM-BLO	FFB-03-000
M1	Voltmeter, 0-20 V	EBP-20-041
M2	Ammeter, 0-1.5 A	EDN-15-035
Q1	Transistor, NPN	FBN-36220
Q2, Q3	Not assigned	
Q101, Q102	Transistor, NPN	FBN-L109
R1, R2	Res., dual, var., ww, 3,800 ohms/ 200 ohms ±5%, 2 w (1 req'd)	DNS-40-061
R103	Res., comp., 10,000 ohms ±10%, ½ w	DEB-1031
R104	Res., ww, 1,200 ohms ±2%, 3 w	DFS-12-016
R105	Not assigned	
R107	Res., ww, 0.22 ohm ±5%, 5 w	DFM-22-045
R114	Res., comp., 330 ohms ±10%, ¼ w	DCB-3311
R115	Res., comp., 3,300 ohms ±10%, ½ w	DEB-3321

UNIQUE PARTS (Cont.)
MODEL LP411A-FM (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R116, R117	Not assigned	
R121	Res., comp., 47,000 ohms ±10%, ¼ w	DCB-4731
R122	Not assigned	
T1	Transformer	ABA-411B

MODEL LP412A-FM

C10	Cap., elect., 70 mf, -10 +100%, 90 vdc	CBP-70-012
C103, C104	Not assigned	
C106	Cap., mylar, 0.0022 mf, ±10%, 200 vdc	CGK-22-008
C107	Cap., elect., 3.0 mf, -10 +75%, 100 vdc	CBN-30-015
C108	Cap., mylar, 0.018 mf, ±10%, 200 vdc	CGL-18-005
C109	Cap., elect., 1,000 mf, -10 +100%, 75 vdc	CBS-10-092
C111	Cap., mylar, 0.068 mf, ±10%, 200 vdc	CGL-68-003
CR104	Rectifier	FBL-00-030
CR109, CR110	Not assigned	
CR111, CR112	Rectifier	FBL-00-047
CR113 thru CR116	Not assigned	
CR117 thru CR120	Same as CR111	
CR121 thru CR123	Not assigned	
F102	Fuse, 2.5A, 3AG, NORM-BLO	FFB-02-500
M1	Voltmeter, 0-40 V	EBP-40-042
M2	Ammeter, 0-1A	EDN-10-034
Q1, Q2	Transistor, NPN	FBN-36487
Q3	Not assigned	
Q101, Q102	Transistor, NPN	FBN-L108
R1, R2	Res., dual var., ww, 7,800 ohms/ 200 ohms ±5%, 2 w (1 req'd)	DNS-80-062
R103	Res., comp., 33,000 ohms ±10%, ½ w	DEB-3331
R104	Res., ww, 1,800 ohms ±5%, 5 w	DFS-18-026
R105	Res., comp., 330 ohms ±10%, ½ w	DEB-3311
R107	Res., ww, 0.25 ohm ±5%, 5 w	DFM-25-016
R114	Res., comp., 220 ohms ±10%, ¼ w	DCB-2211
R115	Res., comp., 3,300 ohms ±10%, ½ w	DEB-3321
R116, R117	Res., ww, 1.22 ohms ±2%, 3 w	DFN-12-078
R121	Res., comp., 47,000 ohms ±10%, ¼ w	DCB-4731
R122	Not assigned	
T1	Transformer	ABA-412B

UNIQUE PARTS (Cont.)

MODEL LP413A-FM

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C10	Cap., elect., 70 mf, -10 +100%, 90 vdc	CBP-70-012
C103, C104	Cap., mylar, 0.018 ±10%, 200 vdc	CGL-18-005
C106	Cap., mylar, 0.0022 mf, ±10%, 200 vdc	CGK-22-008
C107	Cap., elect., 3.3 mf, -10 +50%, 250 vdc	CBN-33-027
C108	Not assigned	
C109	Cap., elect., 200 mf, -10 +100%, 100 vdc	CBR-20-043
C111	Cap., mylar., 0.1 mf, ±10%, 200 vdc	CAM-10-012
CR104, CR109, CR110	Rectifier	FBL-00-036
CR111, CR112	Not assigned	
CR113, CR114	Rectifier	FBL-00-033
CR115 thru CR120	Not assigned	
CR121	Rectifier, zener diode	FBM-Z125
CR122	Not assigned	
CR123	Rectifier	FBL-00-030
F102	Fuse, 1A, 3AG, NORM-BLO	FFB-01-000
M1	Voltmeter, 0-60 V	EBP-60-043
M2	Ammeter, 0-0.5 A	EDM-50-047
Q1	Transistor, NPN	FBN-35902
Q2, Q3	Not assigned	
Q101, Q102	Transistor, NPN	FBN-L108
R1, R2	Res., dual, var, ww, 11,800 ohms/ 200 ohms ±5%, 2 w (1 req'd)	DNT-12-033
R103	Res., comp., 68,000 ohms ±10%, ½ w	DEB-6831
R104	Res., ww, 5,600 ohms ±3%, 3 w	DFS-56-053
R105	Res., comp., 330 ohms ±10%, ½ w	DEB-3311
R107	Res., ww, 0.68 ohm ±5%, 5 w	DFM-68-048
R114	Res., comp., 220 ohms ±10%, ¼ w	DCB-2211
R115	Res., comp., 3,300 ohms ±10%, ½ w	DEB-3321
R116, R117	Not assigned	
R121	Res., comp., 47,000 ohms ±10%, ¼ w	DCB-4731
R122	Res., comp., 5.1 ohms ±5%, ½ w	DEB-51G5
R125, R126	Res., comp., 47 ohms ±10%, ¼ w	DCB-4701
T1	Transformer	ABA-413B

MODEL LP414A-FM

C10	Cap., elect., 30 mf, -10 +100%, 250 vdc	CBP-30-017
C14	Cap., mylar, 0.015 mf, ±10%, 400 vdc	CGL-15-007
C103, C104	Cap., mylar, 0.01 mf, ±10%, 600 vdc	CGL-10-010

UNIQUE PARTS (Cont.)

MODEL LP414A-FM (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C106	Cap., ceramic, 560 pf, ±20%, 1000 vdc	CGJ-56-001
C107	Cap., elect., 3.3 mf, -10 +50%, 250 vdc	CBN-33-027
C108	Not assigned	
C109	Cap., elect., 90 mf, -10 +100%, 250 vdc	CBP-90-015
C111	Cap., mylar, 0.068 mf, ±10%, 400 vdc	CGL-68-004
CR104, CR109	Rectifier	FBL-00-033
CR110 thru CR112	Not assigned	
CR113, CR114	Rectifier	FBL-00-050
CR121	Rectifier	FBM-Z119
CR122	Same as CR113	
CR123	Rectifier	FBL-00-030
F102	Fuse, 0.5A, 3AG, NORM-BLO	FFB-00-500
M1	Voltmeter, 0-120 V	EBR-12-087
M2	Ammeter, 0-300 mA	EDM-30-046
Q1	Not assigned	
Q2, Q3	Transistor, NPN	FBN-L147
Q101	Not assigned	
Q102	Transistor, NPN	FBN-L115
R1	Res., var., ww, 24,000 ohms ±5%, 2 w	DNT-24-071
R2	Not assigned	
R103	Res., comp., 220,000 ohms ±10%, ½ w	DEB-2241
R104	Not assigned	
R105	Res., comp., 330 ohms ±10%, ½ w	DEB-3311
R107	Res., ww, 1.5 ohms ±3%, 3 w	DFN-15-042
R114	Res., comp., 100 ohms ±10%, ¼ w	DCB-1011
R115	Not assigned	
R116, R117	Res., film, 12 ohms ±5%, ½ w	DCP-12-003
R121	Res., comp., 47,000 ohms ±10%, ¼ w	DCB-4731
R122	Res., comp., 10 ohms ±10%, ½ w	DEB-1001
R125	Res., comp., 47 ohms ±10%, ¼ w	DCB-4701
R126	Res., comp., 47 ohms ±10%, ¼ w	DCB-4701
T1	Transformer	ABA-414B

MODEL LP415A-FM

C10	Cap., elect., 8.0 mf, -10 +100%, 400 vdc	CBN-80-021
C103, C104	Not assigned	
C106	Cap., mylar, 0.0033 mf, ±10%, 200 vdc	CGK-33-003
C107	Cap., elect., 3.5 mf, -10 +100%, 400 vdc	CBN-35-035
C108	Cap., paper, 0.01 mf, ±10%, 1000 vdc	CAL-10-021
C109	Cap., elect., 45 mf, -10 +100%, 400 vdc	CBP-45-028
C111	Cap., mylar, 0.068 mf, ±10%, 400 vdc	CGL-68-004

UNIQUE PARTS (Cont.)
MODEL LP415A-FM (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
CR104, CR109	Rectifier	FBL-00-050
CR110 thru CR112	Not assigned	
CR113 thru CR116	Same as CR104	
CR117 thru CR120	Not assigned	
CR121	Rectifier, zener diode	FBM-Z119
CR122	Same as CR104	
CR123	Rectifier	FBL-00-030
F102	Fuse, ¼ A, 3AG, NORM-BLO	FFB-00-250
M1	Voltmeter, 0-250 V	EBR-25-088
M2	Ammeter, 0-100 mA	EDM-10-045
Q1	Not assigned	
Q2, Q3	Transistor, NPN	FBN-L147
Q10	Transistor, NPN	FBN-L115
Q101	Not assigned	
Q102	Same as Q10	
R1	Res., var., ww, 50,000 ohms ±5%, 2 w	DNT-50-070
R2	Not assigned	
R32, R33	Res., comp., 150,000 ohms ±5%, ½ w	DEB-1545
R34	Res., comp., 560 ohms ±10%, ½ w	DEB-5611
R103	Res., comp., 680,000 ohms ±10%, ½ w	DEB-6841
R104	Not assigned	
R105	Same as R34	
R107	Res., ww, 4.0 ohms ±3%, 3 w	DFN-40-043
R114	Res., comp., 470 ohms ±10%, ¼ w	DCB-4711
R115 thru R117	Not assigned	
R121	Res., comp., 68,000 ohms ±10%, ¼ w	DCB-6831
R122	Res., comp., 10 ohms ±10%, ½ w	DEB-1001
R125	Res., comp., 1,000 ohms ±10%, ¼ w	DCB-1021
R126	Res., comp., 100 ohms ±10%, ¼ w	DCB-1011
T1	Transformer	ABA-415B

PARTS FOR "V" OPTION

On all LP400A models with suffix "V", capacitor C12, fuse F101, and transformer T1 change and a resistor is added in series with DS1. Part no. changes for C12, F101, and DS-1 Res. are listed here. For transformer T1 used on these models, see standard LP400A model parts list for the standard transformer part no. and add suffix "G"* to the part no. Price for T1 does not change.

*Suffix "V" on units with serial no. prefix A.

PARTS FOR "V" OPTIONS (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
	ALL MODELS	
C12	Cap., paper, 0.01 mf, ±10%, 1000 vdc	CAL-10-021
F101	Fuse, 1A, 3AG, SLO-BLO	FFC-01-000
DS1 Res.	Res., comp., 120,000 ohms ±10%, ½ w	DEB-1241
	PARTS FOR OVERVOLTAGE PROTECTOR ACCESSORY MODELS LHOV-4, LHOV-5, LHOV-6 COMMON PARTS	
C1	Cap., mylar, 0.01 mf, ±20%, 80 vdc	CGL-10-008
Q1	Transistor, NPN	FBN-L102
Q2	Transistor, PNP	FBN-L114
R2	Res., film, 560 ohms ±2%, ½ w	DCR-56-002
R3	Res., film, 200 ohms ±5%, ½ w	DCR-20-010
R4	Res., thermistor, 425 ohms ±5%, 1¼ w	DKR-43-004
R5, R6	Res., comp., 1,200 ohms ±10%, ½ w	DEB-1221
R7	Res., comp., 33 ohms ±5%, ¼ w	DCB-3305
R8	Res., comp., 15,000 ohms ±10%, ½ w	DEB-1531
R9	Res., comp., 22 ohms ±10%, ½ w	DEB-2201
R10	Same as R5	
SCR1	Rectifier, silicon controlled	FBP-00-009
	UNIQUE PARTS MODEL LHOV-4	
R1	Res., var., ww or cermet, 10,000 ohms ±10%, ¾ w	DNT-10-045
	MODEL LHOV-5	
R1	Res., var., ww or cermet, 20,000 ohms ±10%, ¾ w	DNT-20-010
	MODEL LHOV-6	
R1	Res., var., ww, 30,000 ohms ±10%, 0.6 w	DNT-30-027

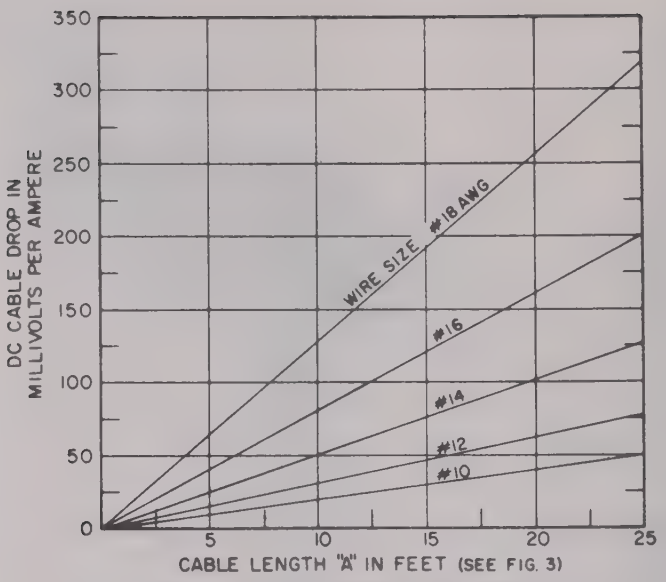


FIG. 1. 2-WIRE CONNECTION (SEE FIG. 4)

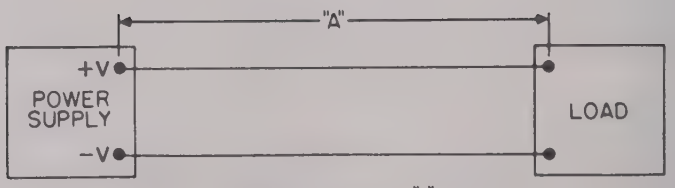
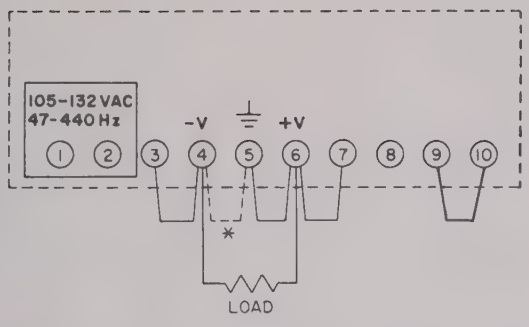
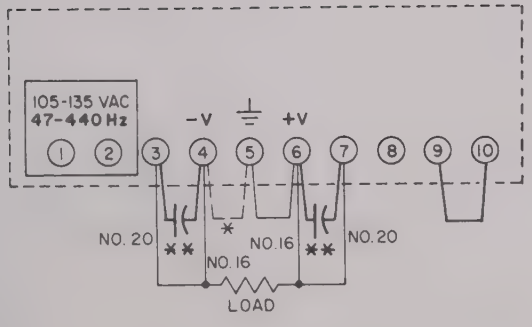


FIG. 2. CABLE LENGTH "A" IN FEET



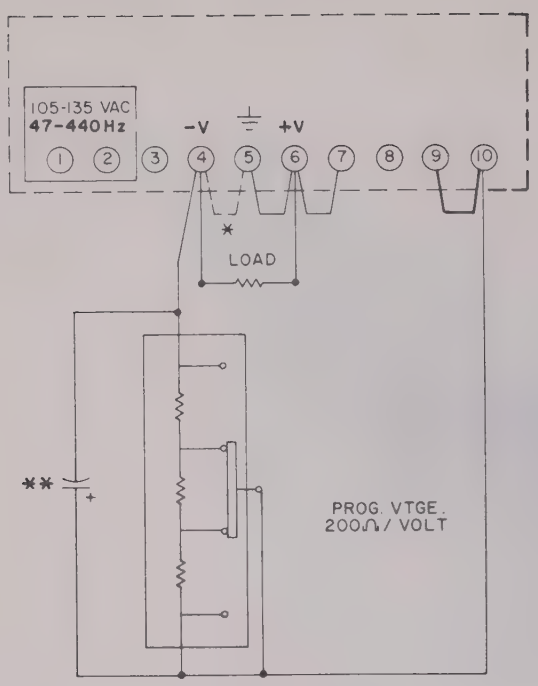
NOTE:
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 4 AND 5.

FIGURE 3. TWO-WIRE CONNECTION

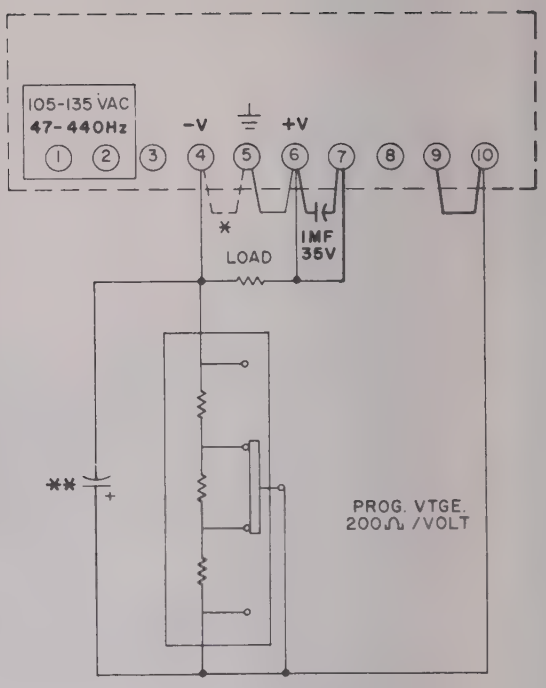


NOTE:
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 4 AND 5.
** 1 MF, 35V, ELECT. MAY BE REQUIRED TO ELIMINATE NOISE PICK-UP.

FIGURE 4. FOUR-WIRE CONNECTION



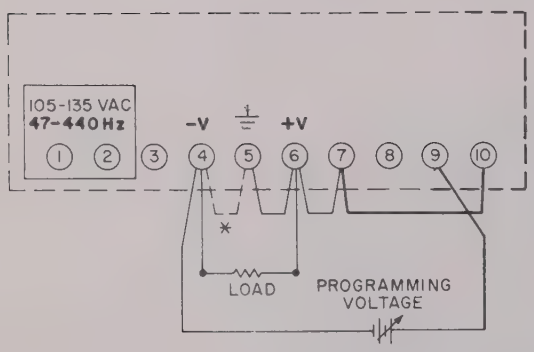
(A) LOCAL SENSING



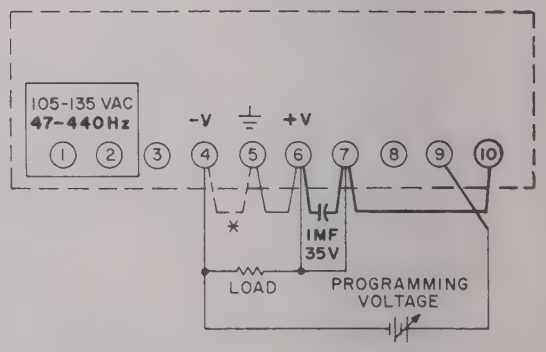
(B) REMOTE SENSING

NOTE:
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 4 AND 5.
** 3 MF, 100V USED ON MODELS LP-410A-FM — LP-412A-FM
3 MF, 400V USED ON MODELS LP-413A-FM — LP-415A-FM

FIGURE 5. PROGRAMMED VOLTAGE, WITH EXTERNAL RESISTOR



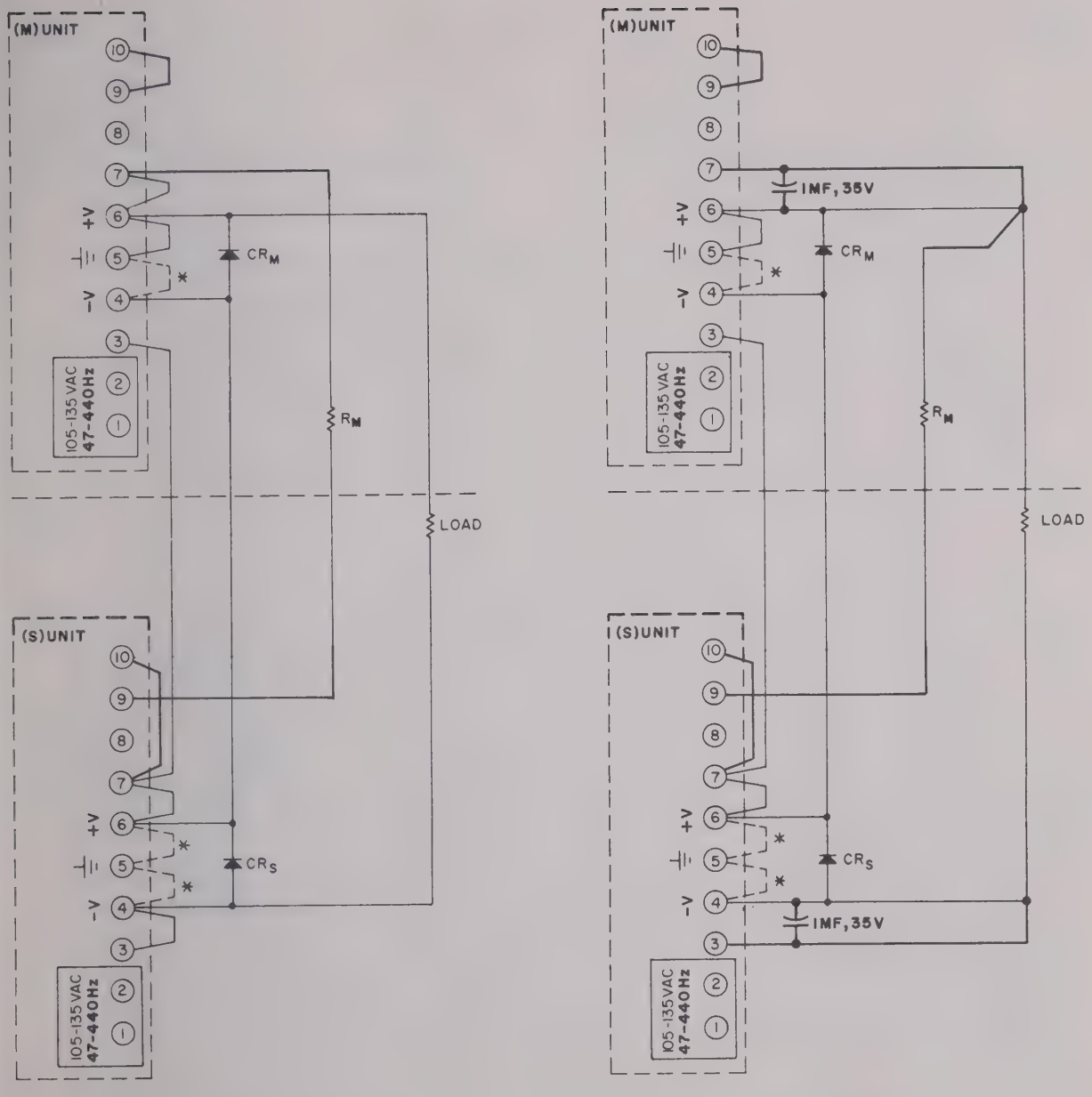
(A) LOCAL SENSING



(B) REMOTE SENSING

NOTE:
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 4 AND 5.

FIGURE 6. PROGRAMMED VOLTAGE, WITH EXTERNAL PROGRAMMING VOLTAGE SOURCE

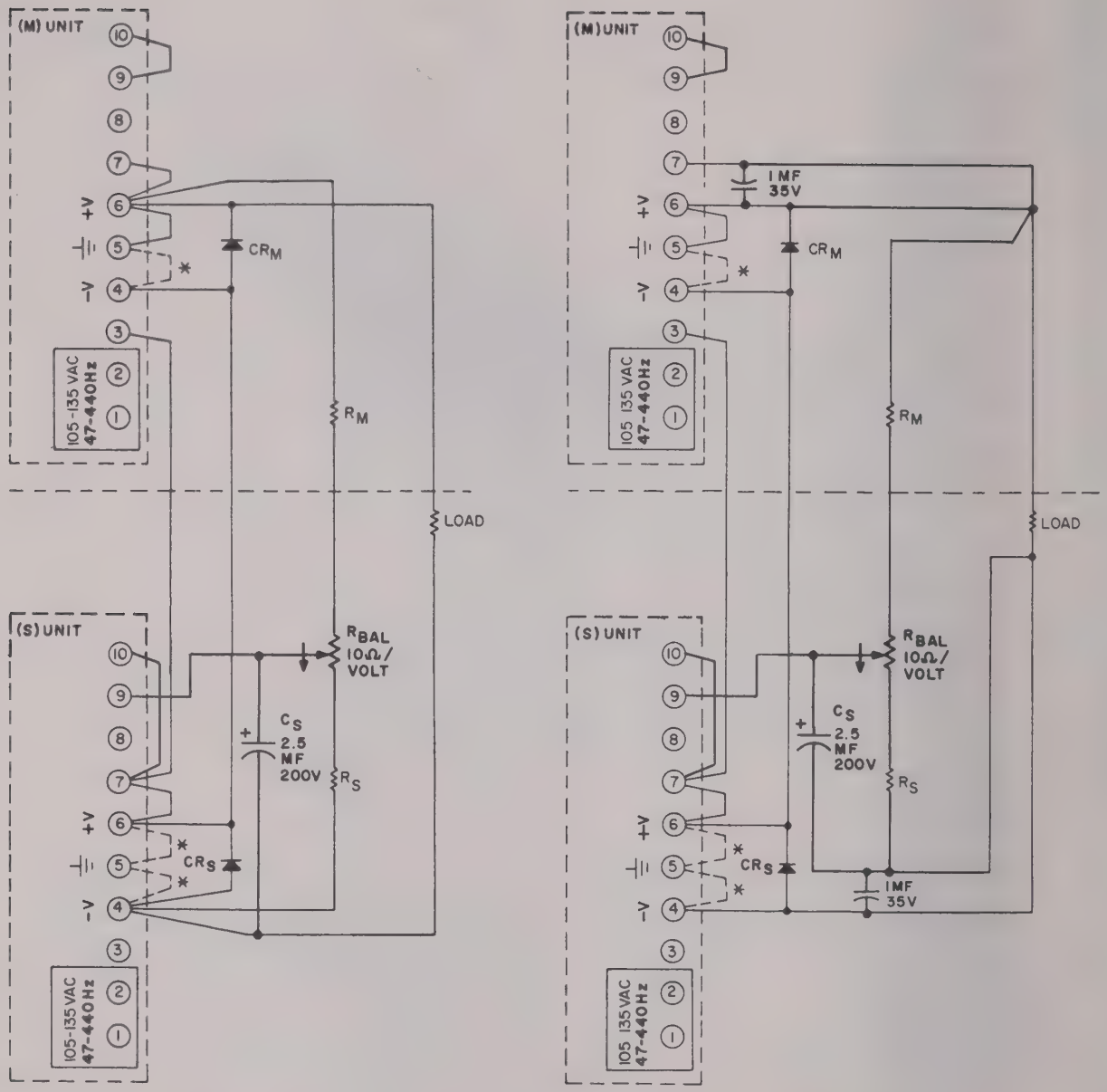


(A) LOCAL SENSING

(B) REMOTE SENSING

NOTE:
* MAKE ONLY ONE GROUND CONNECTION FOR THE SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FORM TERMINALS 5 AND 6 ON (M) UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

FIGURE 7. SERIES CONNECTION

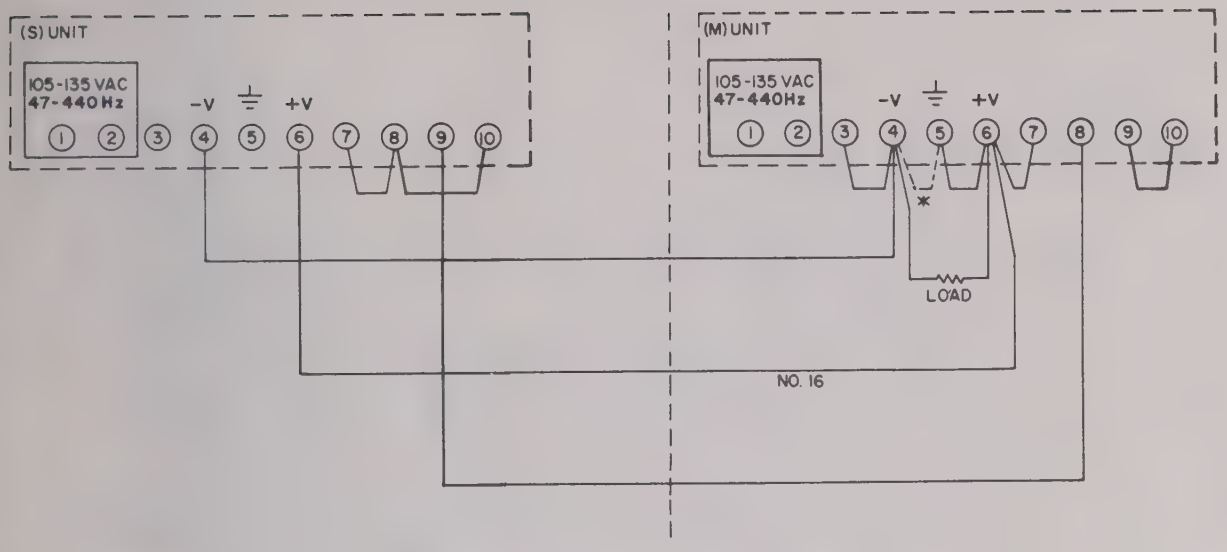


(A) LOCAL SENSING

(B) REMOTE SENSING

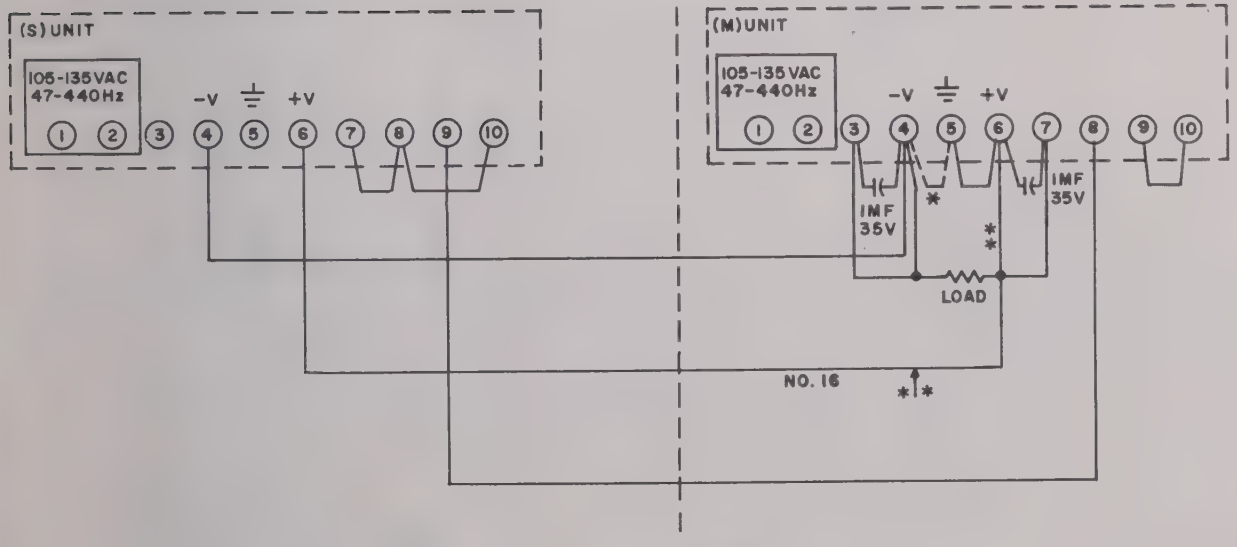
NOTE:
* MAKE ONLY ONE GROUND CONNECTION FOR THE SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON (M) UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

FIGURE 8. ALTERNATE SERIES CONNECTION



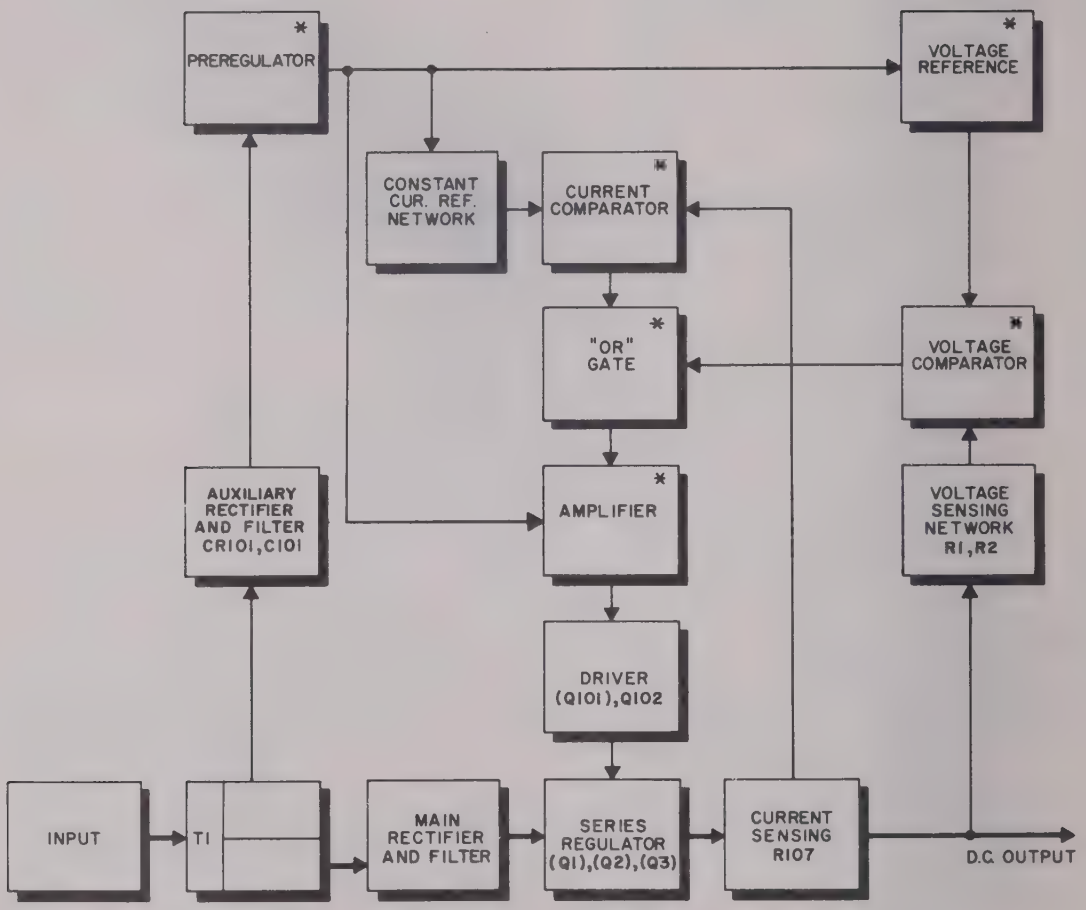
NOTE:
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 4 AND 5.

FIGURE 9. PARALLEL CONNECTION, LOCAL SENSING



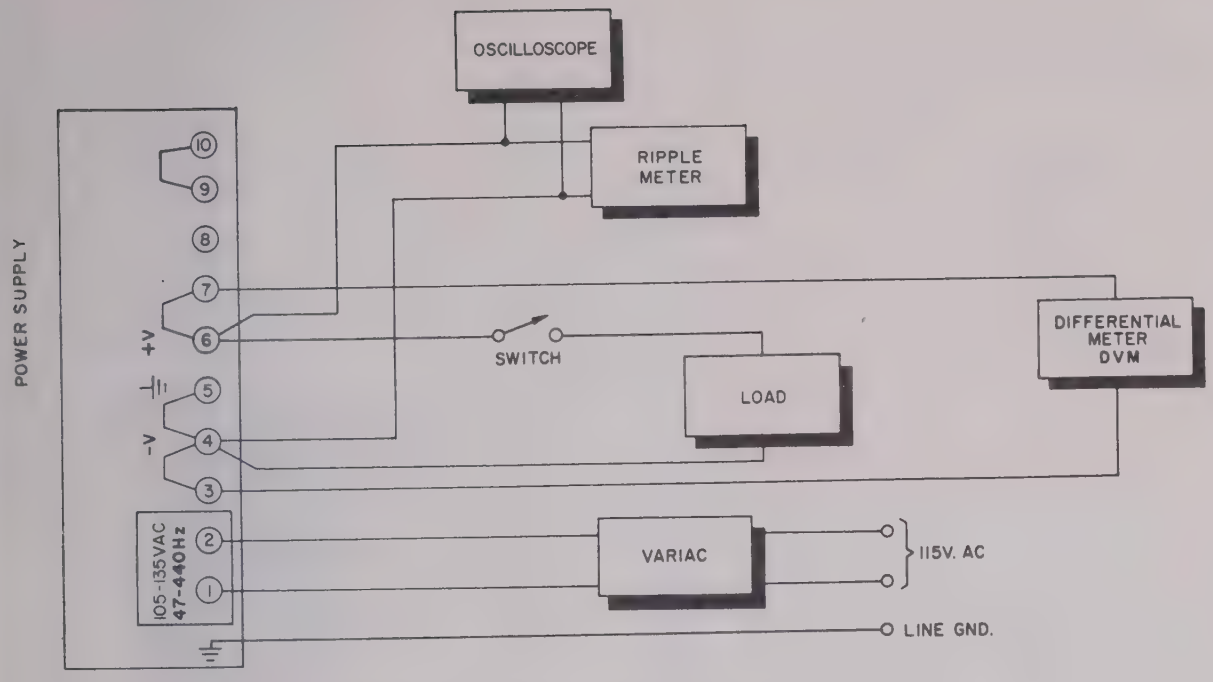
NOTE:
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 4 AND 5.
** LEAD LENGTHS MUST BE EQUAL.

FIGURE 10. PARALLEL CONNECTION, REMOTE SENSING



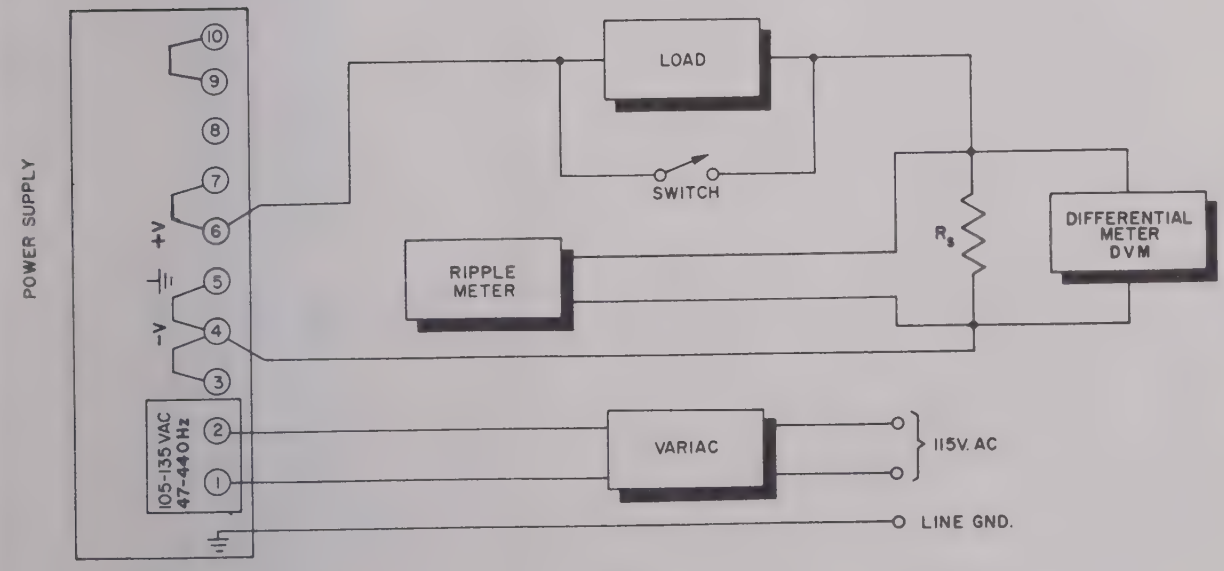
* THIS CIRCUIT ELEMENT IS LOCATED IN IC101.

FIGURE II. TYPICAL BLOCK DIAGRAM.



NOTES:
1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE-WIRE LINE CORD TO GROUND.
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTIONS ONLY.

FIGURE 12. TEST CONNECTIONS FOR CONSTANT VOLTAGE PERFORMANCE CHECKS



NOTES:
1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE-WIRE LINE CORD TO GROUND.
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTIONS ONLY.

FIGURE 13. TEST CONNECTIONS FOR CONSTANT CURRENT PERFORMANCE CHECKS

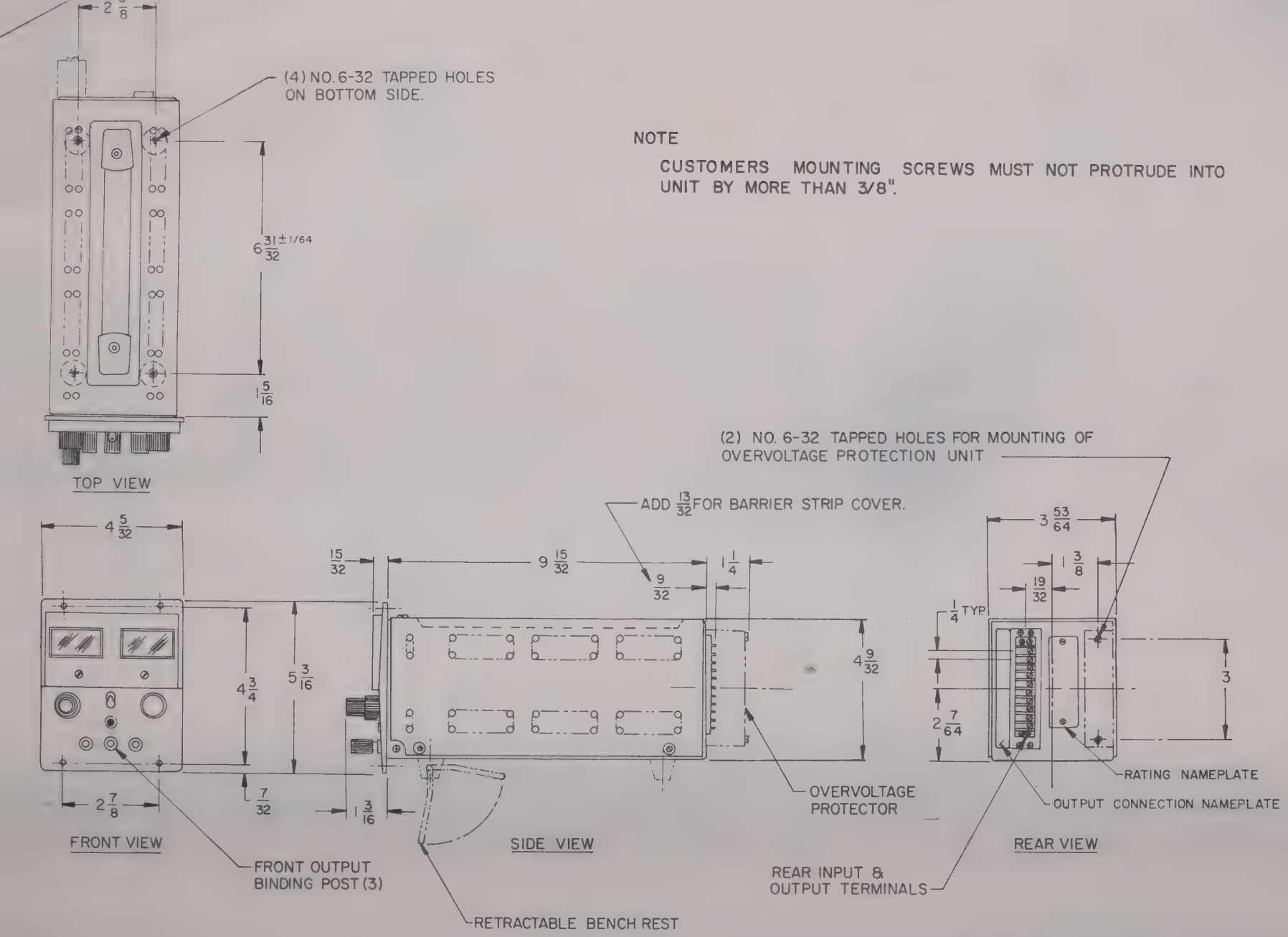
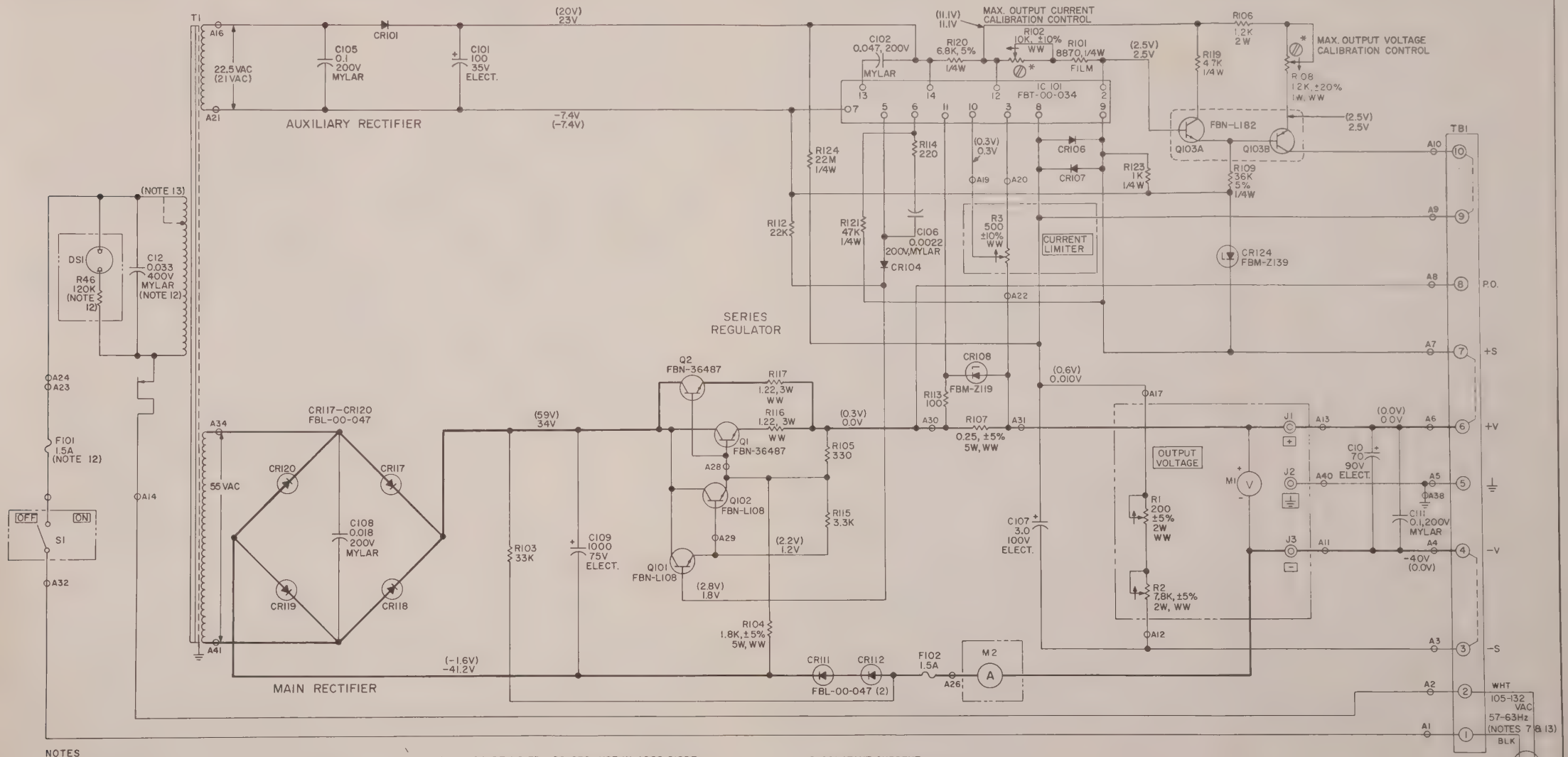

(4) NO. 6-32 TAPPED HOLES ON BOTTOM SIDE.
NOTE
CUSTOMERS MOUNTING SCREWS MUST NOT PROTRUDE INTO UNIT BY MORE THAN 3/8".
TOP VIEW
(2) NO. 6-32 TAPPED HOLES FOR MOUNTING OF OVERVOLTAGE PROTECTION UNIT
ADD 13/32 FOR BARRIER STRIP COVER.
FRONT VIEW
SIDE VIEW
REAR VIEW
FRONT OUTPUT BINDING POST (3)
RETRACTABLE BENCH REST
OVERVOLTAGE PROTECTOR
RATING NAMEPLATE
OUTPUT CONNECTION NAMEPLATE
REAR INPUT & OUTPUT TERMINALS

Figure 14. Outline Drawing



NOTES

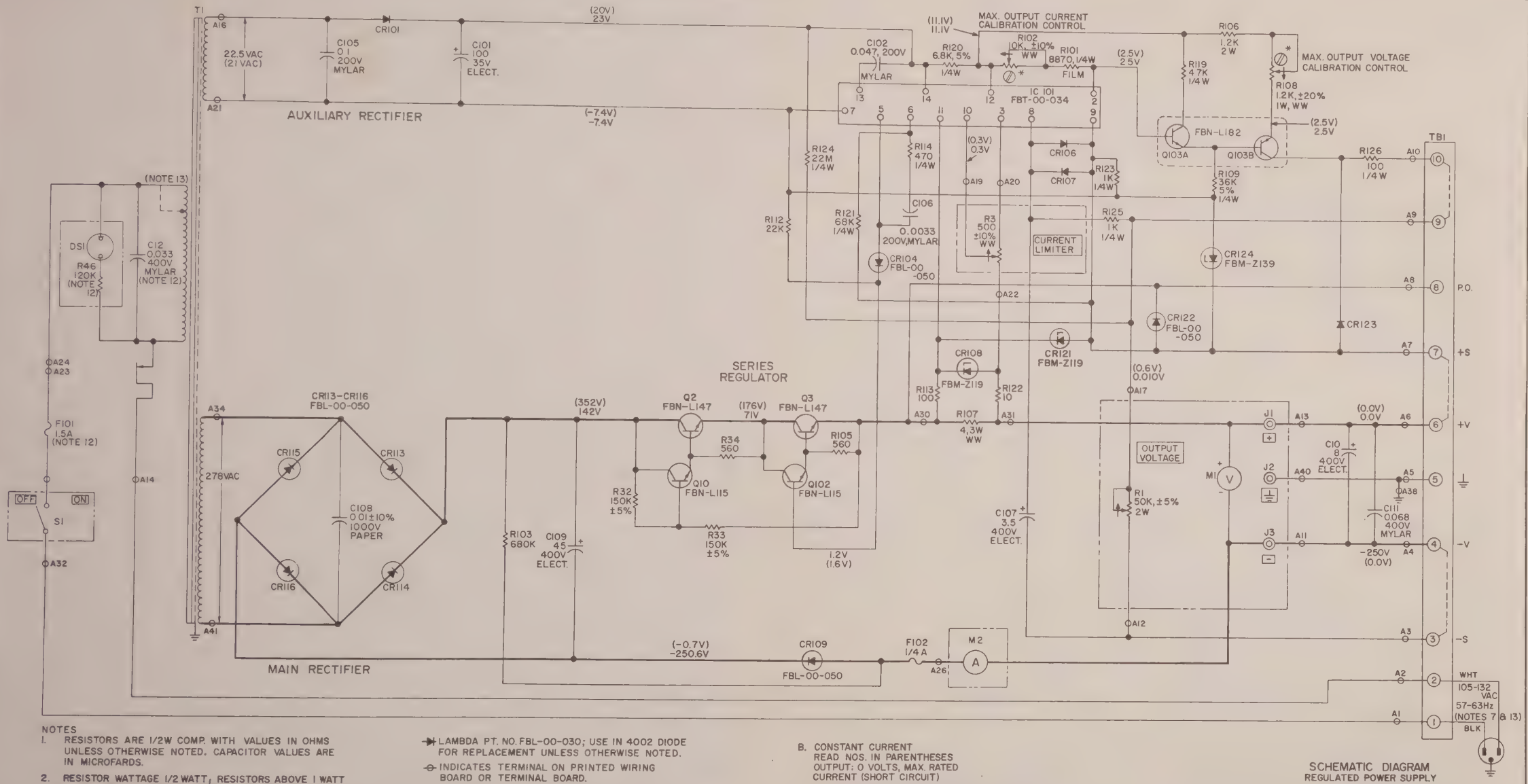
1. RESISTORS ARE 1/2W COMP. WITH VALUES IN OHMS UNLESS OTHERWISE NOTED. CAPACITOR VALUES ARE IN MICROFARDS.
2. RESISTOR WATTAGE 1/2 WATT, RESISTORS ABOVE 1 WATT ARE WIREWOUND UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES; COMPOSITION ±10%; WIREWOUND ±3%; FILM ± 1%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%, +100%; MYLAR ±10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - ↓ INDICATES CLOCKWISE ROTATION OF SHAFT.
   - ⏚ INDICATES CONNECTION TO CHASSIS.
   - ⊘ INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - ▭ INDICATES ACTUAL UNIT MARKING.
   - * SEE INSTRUCTION MANUAL.
   - ▶| LAMBDA PT. NO. FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - ⊖ INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. FOR OPERATION AT OTHER THAN 57-63 Hz, CONSULT FACTORY.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS, CV AND CC INPUT: 115 VAC, 60Hz; INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 7) & INDICATED POINTS UNLESS NOTED.
   - A. CONSTANT VOLTAGE
     READ NOS. NOT IN PARENTHESES
     OUTPUT: MAX RATED VOLTAGE, ZERO CURRENT
   - B. CONSTANT CURRENT
     READ NOS. IN PARENTHESES
     OUTPUT: 0 VOLTS, MAX. RATED CURRENT (SHORT CIRCUIT)
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. ⬚ INDICATES FRONT-PANEL MOUNTED COMPONENT.
11. WHEN REPLACING Q102, RETAIN RADIATOR AND INSTALL WITH NEW PART.
12. FOR UNITS WITH "V" OPTION, F101 IS 3/4 AMP, R46 IS ADDED AND C12 IS 0.01 uf ±10%, 1000V, PAPER.
13. ON UNITS WITH "V" OPTION, T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TAP), OR FOR 205-265V (USING ENTIRE PRIMARY). ON SERIAL NO. PREFIX A, "V" OPTION UNITS; T1 PRIMARY IS NOT TAPPED. AC INPUT IS 205-265V.

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.
DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIXES A&B

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY
MODEL
LP-412A-FM

LAMBDA
ELECTRONICS
MELVILLE, NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.



NOTES

1. RESISTORS ARE 1/2W COMP. WITH VALUES IN OHMS UNLESS OTHERWISE NOTED. CAPACITOR VALUES ARE IN MICROFARDS.
2. RESISTOR WATTAGE 1/2 WATT, RESISTORS ABOVE 1 WATT ARE WIREWOUND UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES; COMPOSITION ±10%; WIREWOUND ±3%; FILM ± 1%, UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%, +100%; MYLAR ±10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - ↓ INDICATES CLOCKWISE ROTATION OF SHAFT.
   - ⏚ INDICATES CONNECTION TO CHASSIS.
   - ⊘ INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - ▭ INDICATES ACTUAL UNIT MARKING.
   - * SEE INSTRUCTION MANUAL.
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. FOR OPERATION AT OTHER THAN 57-63 Hz, CONSULT FACTORY.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS, CV AND CC INPUT. 115 VAC, 60Hz; INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 7) & INDICATED POINTS UNLESS NOTED.
   - A. CONSTANT VOLTAGE
     READ NOS. NOT IN PARENTHESES
     OUTPUT: MAX RATED VOLTAGE, ZERO CURRENT
   - B. CONSTANT CURRENT
     READ NOS. IN PARENTHESES
     OUTPUT: 0 VOLTS, MAX. RATED CURRENT (SHORT CIRCUIT)
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. ⬚ INDICATES FRONT-PANEL MOUNTED COMPONENT.
11. WHEN REPLACING Q102 & Q10, RETAIN RADIATOR AND INSTALL WITH NEW PART.
12. FOR UNITS WITH "V" OPTION, F101 IS 3/4 AMP, R46 IS ADDED AND C12 IS 0.01 uf ±10%, 1000V, PAPER.
13. ON UNITS WITH "V" OPTION, T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TAP), OR FOR 205-265V (USING ENTIRE PRIMARY). ON SERIAL NO. PREFIX A, "V" OPTION UNITS; T1 PRIMARY IS NOT TAPPED. AC INPUT IS 205-265V.

→ LAMBDA PT. NO. FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.

⊖ INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.
DOTTED CONNECTIONS SHOWN ON TBI INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIXES A&B

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

MODEL
LP-415A-FM

LAMBDA
ELECTRONICS
MELVILLE, NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.

GENERAL DESCRIPTION

Rack adapter LRA-1 is designed for use in equipment racks where ruggedized mounting of units is required. The adapter can be used with or without chassis slides.

Rack adapter LRA-2 is designed for simple applications of rack installation where chassis slides and ruggedized mounting of equipment are not required.

Both rack adapter LRA-1 and LRA-2 can be used to install 1/4-rack or 1/2-rack power supply units into equipment racks. Each adapter can accept various combinations of 1/4 and 1/2-rack units up to four 1/4-rack units or two 1/2-rack units.

INSTALLATION OF 1/2 RACK UNITS INTO LRA-1

To install 1/2-rack power supply units, remove slide numbers 2 and 3 and/or 6 and 7, together with securing hardware and associated slide bar nut.

Using slide screws and slide bar nuts that were removed, store removed slides on the frame at the rear of the adapter where screw clearance holes are provided for securing each slide to the adapter.

SHIPMENT OF UNITS MOUNTED IN LRA-1

To protect the unit against damage from shock and vibrations when transporting adapter with installed units, eight universal tie-down mounting holes, located in the adapter base, at the rear of the rack adapter, are used to secure 1/4-rack and/or 1/2-rack units into the rack adapter. Secure each unit using two 6-32 x 5/8 screws, two lock-washers and two spacers installed from the bottom side of the rack adapter. See detail A for typical securing hardware. Eight spacers are supplied with rack adapter LRA-1.

RUGGEDIZED MOUNTING

When ruggedized mounting of units is required, follow the procedure described for SHIPMENT OF UNITS MOUNTED IN LRA-1. See detail A for typical securing hardware.

MOUNTING CHASSIS SLIDES

Mount chassis slides uning the following hardware. To assure unrestricted mounting of units into the adapter designated screw lengths must not be exceeded. Insert screws into designated holes and secure slide in position using long bar nut supplied with rack adapter LRA-1.

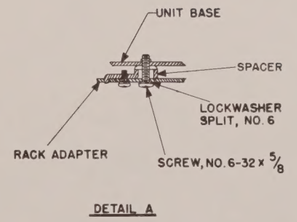
CHASSIS TRAK NO. CTS. -116:
10-32 x 7/16 fl-hd (82°);
use A holes.

LAMBDA NO. KHT-34-003 (1 PR)
6-32 x 3/8 pan-hd;
use B, C, and D holes.

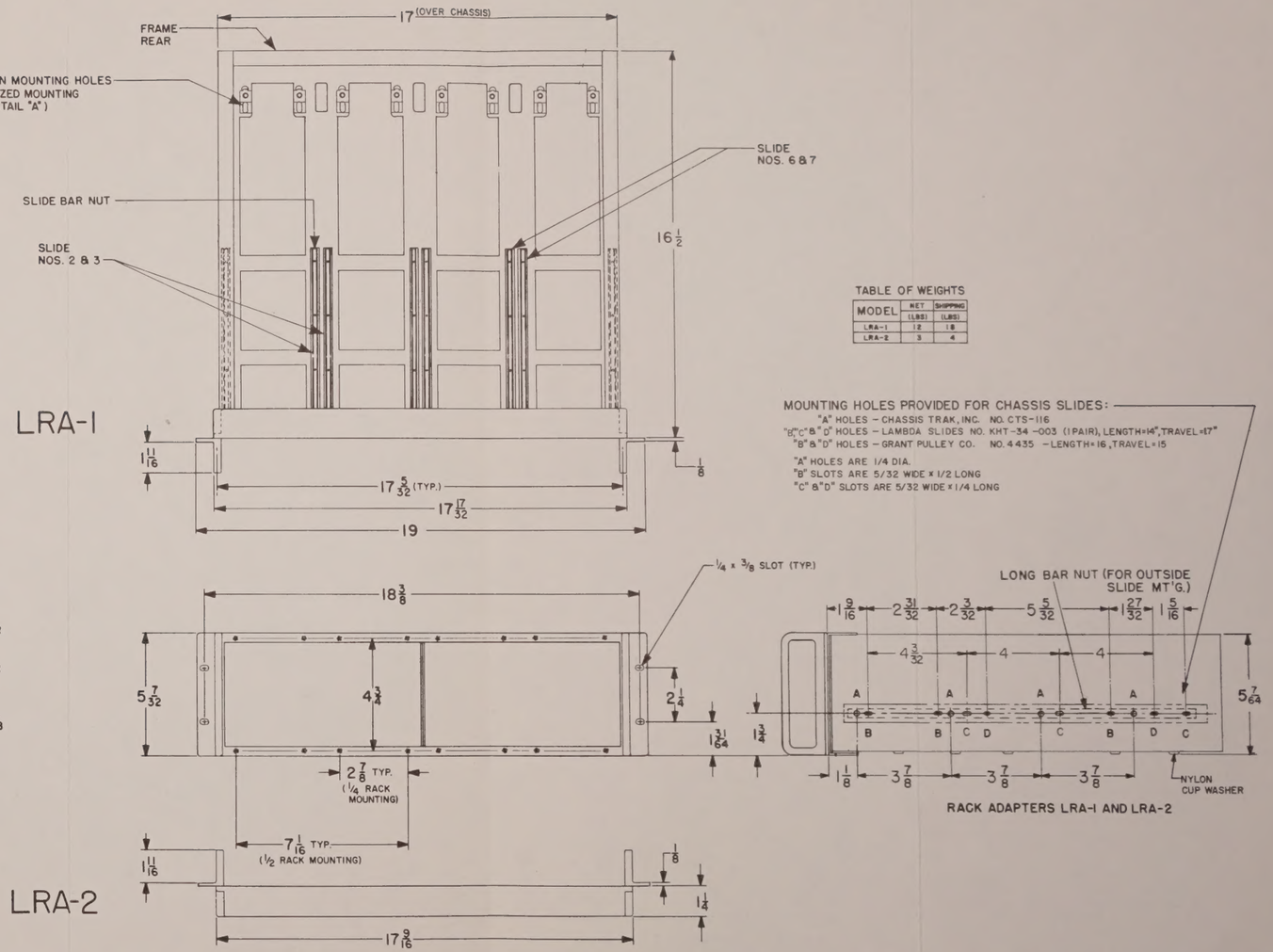
GRANT PULLEY NO. 4435:
6-32 x 5/15 fl-hd (100°);
use B and D holes.

USING BLANK PANELS

Blank front panels Model LBP-11 and LBP-21 are available for covering any 1/4-rack or 1/2-rack opening respectively. The blank panels can be used with rack adapter LRA-1 and LRA-2 whenever a 1/4-rack or 1/2-rack space in the adapter is not occupied by a unit. Secure each panel in position using four 6-32 x 3/8 pan-head screws supplied with the rack adapter.



DETAIL A



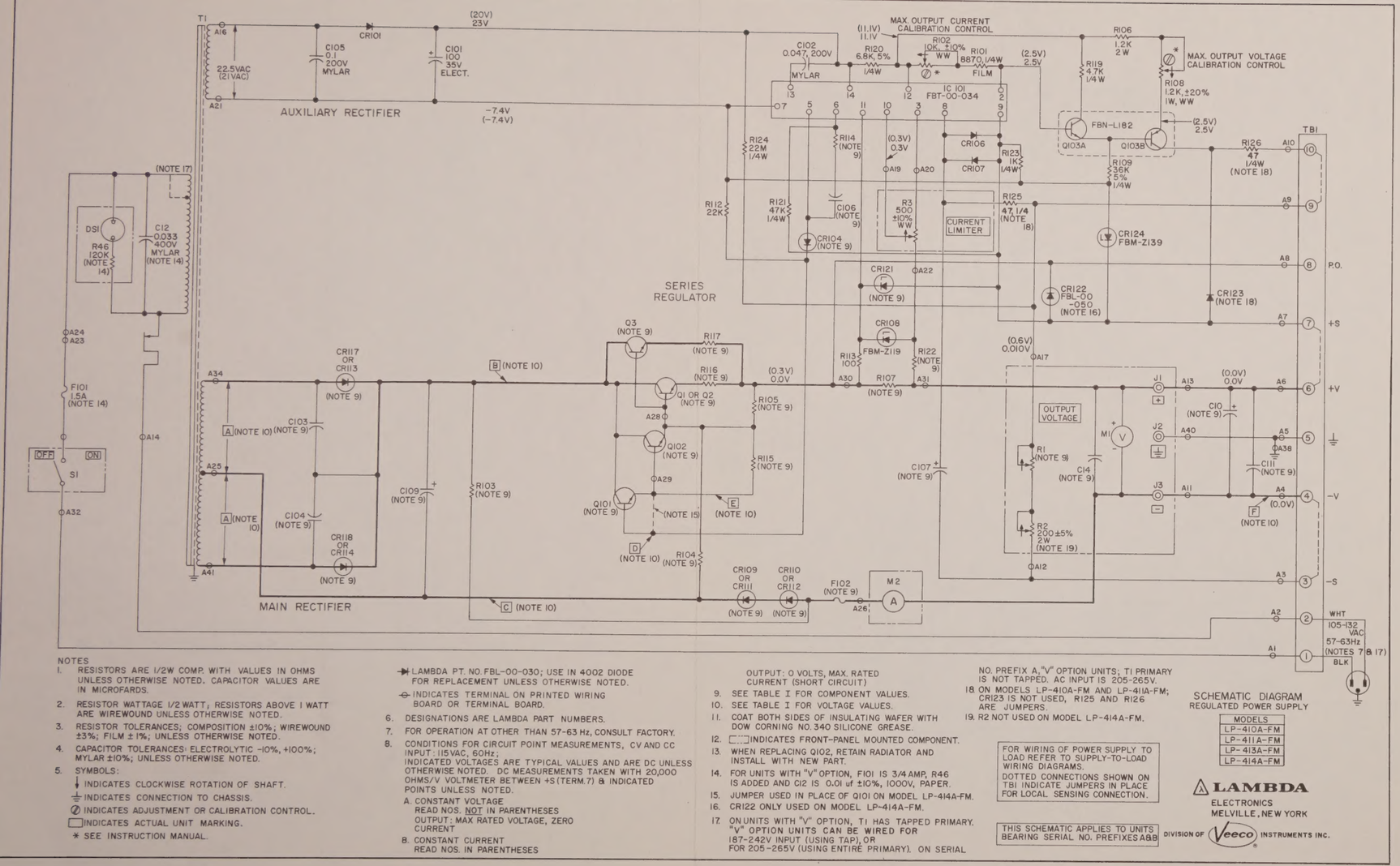
MOUNTING HOLES PROVIDED FOR CHASSIS SLIDES:
"A" HOLES – CHASSIS TRAK, INC. NO. CTS-116
"B" "C" & "D" HOLES – LAMBDA SLIDES NO. KHT-34-003 (1 PAIR), LENGTH=14", TRAVEL=17"
"B" & "D" HOLES – GRANT PULLEY CO. NO. 4435 – LENGTH=16, TRAVEL=15
"A" HOLES ARE 1/4 DIA.
"B" SLOTS ARE 5/32 WIDE x 1/2 LONG
"C" & "D" SLOTS ARE 5/32 WIDE x 1/4 LONG

TABLE OF WEIGHTS

MODEL	NET (LBS)	SHIPPING (LBS)
LRA-1	12	18
LRA-2	3	4

RACK ADAPTERS LRA-1 AND LRA-2

Figure 15. Rack Adapters LRA-1 and LRA-2



NOTES

1. RESISTORS ARE 1/2W COMP. WITH VALUES IN OHMS UNLESS OTHERWISE NOTED. CAPACITOR VALUES ARE IN MICROFARDS.
2. RESISTOR WATTAGE 1/2 WATT; RESISTORS ABOVE 1 WATT ARE WIREWOUND UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES; COMPOSITION ±10%; WIREWOUND ±3%; FILM ±1%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES: ELECTROLYTIC −10%, +100%; MYLAR ±10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - ↓ INDICATES CLOCKWISE ROTATION OF SHAFT.
   - ⏚ INDICATES CONNECTION TO CHASSIS.
   - ⊘ INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - ▭ INDICATES ACTUAL UNIT MARKING.
   - * SEE INSTRUCTION MANUAL.

- ▶| LAMBDA PT. NO. FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
- ⊖ INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.

6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. FOR OPERATION AT OTHER THAN 57-63 Hz, CONSULT FACTORY.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS, CV AND CC INPUT: 115 VAC, 60Hz;
   INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 7) & INDICATED POINTS UNLESS NOTED.
   - A. CONSTANT VOLTAGE
     READ NOS. NOT IN PARENTHESES
     OUTPUT: MAX RATED VOLTAGE, ZERO CURRENT
   - B. CONSTANT CURRENT
     READ NOS. IN PARENTHESES

   OUTPUT: 0 VOLTS, MAX. RATED CURRENT (SHORT CIRCUIT)

9. SEE TABLE I FOR COMPONENT VALUES.
10. SEE TABLE I FOR VOLTAGE VALUES.
11. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
12. ⬚ INDICATES FRONT-PANEL MOUNTED COMPONENT.
13. WHEN REPLACING Q102, RETAIN RADIATOR AND INSTALL WITH NEW PART.
14. FOR UNITS WITH "V" OPTION, F101 IS 3/4 AMP, R46 IS ADDED AND C12 IS 0.01 uf ±10%, 1000V, PAPER.
15. JUMPER USED IN PLACE OF Q101 ON MODEL LP-414A-FM.
16. CR122 ONLY USED ON MODEL LP-414A-FM.
17. ON UNITS WITH "V" OPTION, T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TAP), OR FOR 205-265V (USING ENTIRE PRIMARY). ON SERIAL NO. PREFIX A, "V" OPTION UNITS; T1 PRIMARY IS NOT TAPPED. AC INPUT IS 205-265V.
18. ON MODELS LP-410A-FM AND LP-411A-FM; CR123 IS NOT USED, R125 AND R126 ARE JUMPERS.
19. R2 NOT USED ON MODEL LP-414A-FM.

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS.
DOTTED CONNECTIONS SHOWN ON TBI INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION.

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIXES A8B

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

MODELS
LP-410A-FM
LP-411A-FM
LP-413A-FM
LP-414A-FM

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MELVILLE, NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.

* LAMBDA PART NUMBER

TABLE I (Cont)

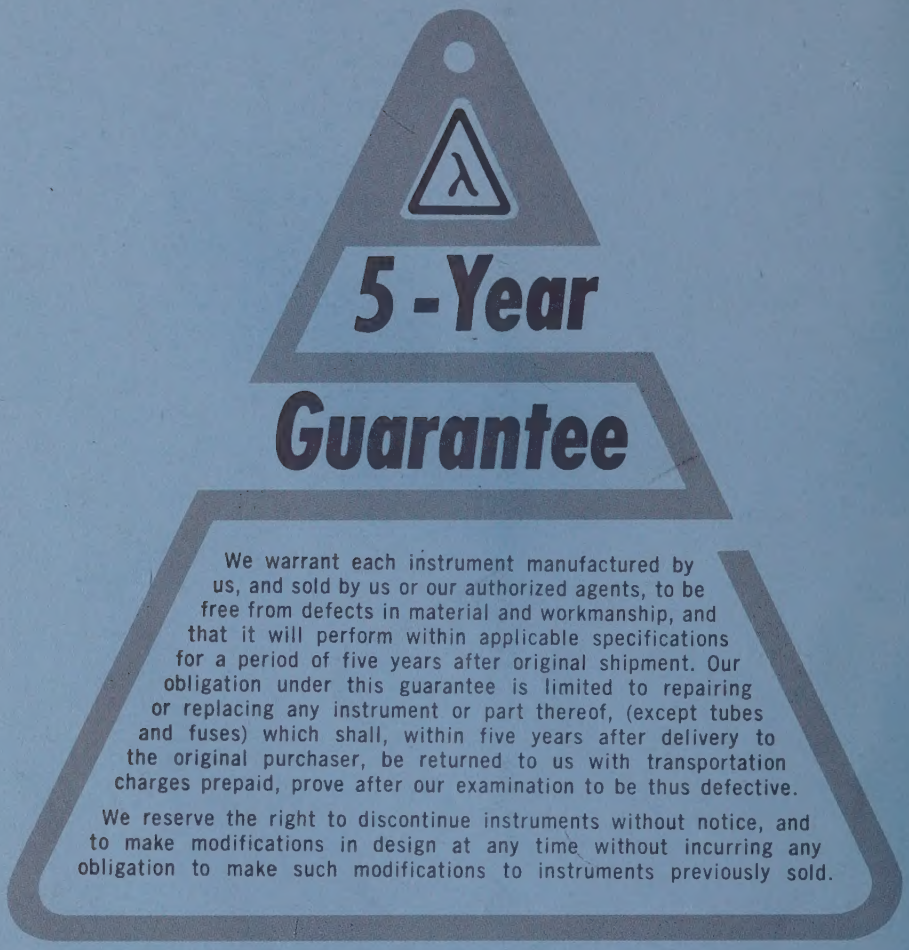
Model	Schematic Components (Cont.) CR121	F102	Q1	Q2, Q3	Q101, Q102	R1	R103	R104	R105	R107	R114	R115	R116, R117	R122
LP-410A-FM	*FBM-	*FBN-	*FBN-	*FBN-	*FBN-	±5% WW	±10% 1/2W COMP	WW	±10% 1/2W COMP	WW	±10% 1/4W COMP	±10% 1/2W COMP	±5% 1/2W FILM	±10% 1/2W COMP
LP-411A-FM	Not Used	AMPS	Not Used	Not Used	L109	1.8K	4.7K	3W	Not Used	0.166 ±5% 5W	330	3.3K	Not Used	Jumper
LP-413A-FM	2125	1	35902	Not Used	L108	11.8K	68K	1.8K ±5%	330	0.22 ±5% 5W	330	3.3K	Not Used	Jumper
LP-414A-FM	2119	0.5	Not Used	L14T	L115 (Q101 Jumped)	24K	220K	Not Used	330	1.5 ±5% 5W	100	Not Used	12	10

* LAMBDA PART NUMBER

TABLE I

SCHEMATIC DATA REFERENCES
MODELS LP-410A-FM, LP-411A-FM
LP-413A-FM, LP-414A-FM

Model	Schematic Voltage Measurements A (VAC)	B (VDC)	C (VDC)	D (VDC)	E (VDC)	F (VDC)	Schematic Components C10	C14	C103, C104	C106	C107	C109	C111	CR104	CR109, CR110	CR111, CR112 CR117, CR118	CR113, CR114
LP-410A-FM	23	21 (24)	-10.6 (-0.8)	1.8 (2.2)	1.2 (1.6)	-10	400mf 30vdc	Not used	0.018mf 200vdc	0.0022mf 200vdc	3mf -10 + 100% 100vdc	1500mf 30vdc	0.1mf 200vdc	030	Not used	*FBL-00- 047 (CR12 Jumped)	Not used
LP-411A-FM	34	28 (37)	-21.2 (-1.6)	1.8 (2.2)	1.2 (1.6)	-20	400mf 30vdc	Not used	0.018mf 200vdc	0.0022mf 200vdc	3mf -10 + 100% 100vdc	1000mf 40vdc	0.1mf 200vdc	030	Not used	*FBL-00- 047	Not used
LP-413A-FM	61	55 (90)	-61.2 (-1.2)	1.8 (2.2)	1.2 (1.6)	-80	70mf 90vdc	Not used	0.018mf 200vdc	0.0022mf 200vdc	3.3mf -10 + 50% 250vdc	200mf 100vdc	0.1mf 200vdc	036	033 (CR110 Jumped)	036	Not used
LP-414A-FM	142	82 (167)	-120.6 (-0.6)	1.8 (3.4)	1.2 (2.8)	-120	30mf 250vdc	0.015mf 400vdc	0.01mf 600vdc	560mmf 200vdc	3.3mf -10 + 50% 250vdc	90mf 250vdc	0.068mf 400vdc	033	033 (CR110 Jumped)	Not used	050


5-Year
Guarantee
We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.
We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

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